Care and cure

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Publication date:
2013

Document Version
Publisher's PDF, also known as Version of record

Care and Cure: Compete or Collaborate?
Improving Inter-Organizational Designs in Healthcare
A Case Study in Dutch Perinatal Care

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The research for this thesis was performed at CentER, Tilburg School of Economics and Management, Tilburg University, Tilburg, the Netherlands.

The research was self-financed, with the exception of the first year, which was financially supported by CZ-Zorgverzekeringen.

Printed by Prisma Print Tilburg

ISBN: 978 90 5668 364 1

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Proefschrift ter verkrijging van de graad van doctor
aan Tilburg University
op gezag van de rector magnificus,
prof.dr. Ph. Eijlander,
in het openbaar te verdedigen ten overstaan van een
door het college voor promoties aangewezen commissie
in de aula van de Universiteit

op woensdag 9 oktober 2013 om 16.15 uur

door

Angèle Johanna Hubertina Maria Pieters,
geboren op 24 maart 1978 te Weert.

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Content

Chapter 1.

Introduction

1.1 Background

Improving the performance of the healthcare sector is a task of major societal importance. In developed countries, the healthcare sector is a large industry, representing between 15% and 25% of the Gross National Product (OECD, 2012). Although there are remarkable gains in life expectancy in the last decades, the sector is facing a multitude of problems today: a steady rise in healthcare spending, which has tended to grow faster than GDP, an alarming rise of obesity rates, a rise of people with chronic conditions, and an aging population (OECD, 2011).

There is much debate about what has been causing problems in the healthcare sector and what may be needed to resolve them. One root cause on which there appears to be a broad consensus is that the design of the services provided in healthcare is in urgent need of improvement (Porter, 2010; Herzlinger, 2004). It is generally recognized that, in healthcare, poor system design creates 'accidents waiting to happen' (Leape et al., 1995). If the fundamental problem indeed is the design of the system, then improvements in care "cannot be achieved by further stressing current systems of care. The current systems cannot do the job. Trying harder will not work. Changing systems of care will" (Institute of Medicine, 2001 p.4).

Traditionally, healthcare services were designed from the perspective of the organization and the professional. Healthcare organizations were organized functionally, per discipline and geographically, with each specialism having its own department or organization (Ben-Tovim et al., 2008; Mintzberg, 1997). As such, healthcare became a highly specialized service where different professionals with different background and cultures, working in different departments or even in different organizations have to work together to deliver high quality care. Apparently, this is not working well: it resulted in fragmented, poorly coordinated care and low service quality (Kenagy, Berwick and Shore, 1999; Herzlinger, 1997; Hilton, 1995). One response is to design healthcare services more from the perspective of the patient. The patient's needs are put first, the patient journey is defined, and the healthcare service and the organization are built around them (Trebble et al., 2010; Curry, McGregor and Tracy, 2006; Ben-Tovim et al., 2008; Bergeson and Dean, 2006; Berry, Carbone and Haeckel, 2002; Laine and Davidoff, 1996). Patient-focused care focuses on a group of patients with similar diagnosis and with similar needs.

In addition, traditionally, and especially in the United States, healthcare is delivered according to the "acute care" model (Bodenheimer, Wagner and Grumback, 2002; Wagner et al., 2001a). It is specialist care, focused on medical intervention, delivered in hospitals. Responsibility for problem solving is directed to the clinician and the responsibility for daily care management is directed to the patient, typically without self-management support

(Cramm, Rutten-Van Molken and Nieboer, 2012). Nowadays, it is more and more recognized that healthcare can be improved by refocus toward proactive maintenance. Care must reach beyond the traditional healthcare organizations into patients' lives in the community (Fromer, 2011; Voelkel, 2000), and patients should be given increased responsibility for the day-to-day management of their disease (Cramm, Rutten-Van Molken and Nieboer, 2012; Peeples and Seley, 2007; Rothman and Wagner, 2003; Glasgow et al., 2001).

1.2 Research Objective

The main goal in a healthcare system is to improve the health of a population (Horvath, 1975), and as such it is not the performance of individual organizations that counts, but the performance of the system as a whole. Therefore this research focuses on the inter-organizational level, on the collection of healthcare organizations that together deliver care to a population in a certain area. Healthcare organizations can vary from large structures, like general or specialized hospitals to small primary care units or health centers. In this thesis the term 'healthcare organizations' will be used, regardless of the variety in legal forms. Essentially, they are the place where supply and demand meet and interact. It is the meeting of two points of view: the one of users or patients seeking care for a health problem and the one of healthcare professionals providing health services in response (Schafer et al., 2010).

There is a prominent and increasing role in healthcare for chronic conditions such as cardiovascular risk, diabetes mellitus, chronic obstructive pulmonary disease, and congestive heart failure. For example, in the United States almost 50% of the adult population has one or more chronic conditions and more than 75% of healthcare costs are due to chronic conditions (Centers for Disease Control and Prevention, 2009). In the Netherlands, as in the rest of Europe, about 30% of the population has one or more chronic conditions, and about 30% of those people have more than one chronic condition (Ursum et al., 2011).

These chronic conditions have in common that patients have needs at three levels (see Figure 1-1). Most of the time, the needs of patients can be met by self-management, by monitoring their condition by themselves. Secondly, patients have needs regarding general, preventive monitoring, education, psycho-sociological support, basic medical support, etcetera. We will call this need a need for *care*. Thirdly, in case of an episode, patients need specialized, medical intervention, what we will refer to as a need for *cure*. Thus, patients need a combination of *care* activities and *cure* activities. Not only do most chronic conditions fit this category, also some mental health disorders (such as depression) and

pregnancy do. The conditions that meet this description will be called *care-cure* conditions in this thesis. They will be discussed in more detail in Chapter 2.

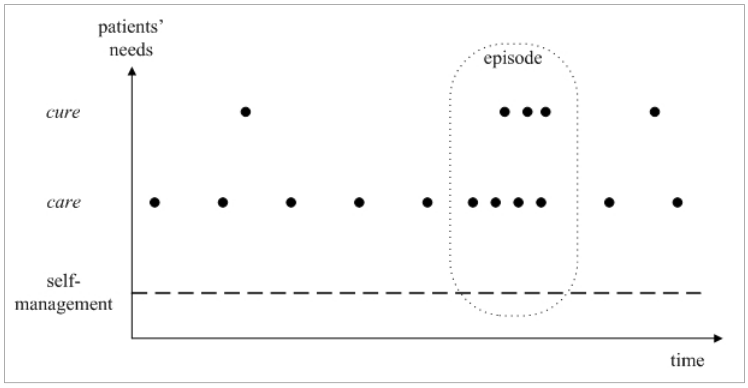

Figure 1-1 Patients' needs

Literature on conditions as COPD, diabetes and mental health in developed countries shows that there are different inter-organizational designs in place, varying from organizations being able to meet both the *care* and the *cure* needs, such as specialty hospitals (Bratcher and Bello, 2011; Bankard et al., 2009; Nocon et al., 2003), to organizations that are specialized in meeting only a specific need, such as community specialized nurses (Utens et al., 2012; Van Dijk et al., 2011; Franx et al., 2009; Audit Commission, 2000) and from organizations that focus on patients with one particular condition, such as specialty hospitals (Nocon et al., 2003), to organizations that focus on various conditions, such as primary care centers. The problems experienced with the different designs are problems of fragmentation and coordination (Johnson et al., 2012; Van Dijk et al., 2011; Mohiddin, Naithani and Gulliford, 2006; England and Lester, 2005; Glasgow et al., 2001; Bindman et al., 1997) and problems of knowledge and experience that professionals have with regard to specific conditions (Mohiddin, Naithani and Gulliford, 2006; White, 2005). This brings us to the research objective:

> *What inter-organizational design would work best for care-cure conditions, so that patients' needs are met, and that problems due to fragmentation are overcome?*

As such, this research aims to contribute to the development of theory regarding inter-organizational designs in the healthcare sector.

1.3 Perspectives

This research is characterized by three perspectives: Firstly, regarding the methodological perspective, this research applies a mixed methods methodology. Secondly, regarding the domain, this research focuses on the healthcare sector and within the healthcare sector on *care-cure* conditions in general and on perinatal care in particular. Thirdly, regarding the research perspective, this research applies an operations strategy and operations management perspective, focusing on inter-organizational designs and their effect on the care process for patients.

1.3.1 Mixed Methods Approach

This research applies a mixed method approach. Mixed methods research combines elements of qualitative and quantitative research approaches for the broad purposes of breadth and depth of understanding and corroboration (Johnson et al., 2007). The use of quantitative and qualitative approaches in combination may provide a better understanding of research problems and complex phenomena than either approach alone, incorporating the strengths of both methodologies and reducing some of the problems associated with singular methods (Creswell and Clark, 2007). Although the number of mixed method studies in management is still fairly low (Taylor and Taylor, 2009), there definitely is an emerging trend towards combining multiple research methodologies to explore research problems in management (Cheng, Choi and Zhao, 2012; Singhal and Singhal, 2012; Cameron and Molina-Azorin, 2011; Taylor and Taylor, 2009). The inter-organizational level, such as supply chains, are a fertile area for research based on multiple perspectives and using a mixed method approach (Singhal and Singhalm 2012).

In this research, different methods are applied, both quantitative and qualitative, such as archival data analysis, questionnaires, interviews, group model building sessions, action research, and simulation. This research aims to contribute to theory building through case study research (Eisenhardt, 1989) and through simulation (Davis, Eisenhardt and Bingham, 2007). The research design and methods applied are presented in more detail in Chapter 3.

1.3.2 Healthcare Sector

As is described above, the domain of this research is the healthcare sector. Since the goal of healthcare is to improve the health of a population, this research focuses on the systems level, on the *inter-organizational* level, instead of on the organizational level. And since the design of the healthcare sector is in urgent need of improvement, this research focuses on the inter-organizational *design*. All this in the field of one particular type of conditions: *care-cure* conditions.

The aim of this research is to contribute to the development of theory regarding inter-organizational design by theory building through case study research and through

simulation. The condition chosen for the case study is pregnancy. Being pregnant is a *care-cure* condition; pregnant women do need both *care* and *cure* expertise. On the one hand they need general monitoring of the progress of the pregnancy and psychosocial care, and on the other hand, they need medical expertise, in case risks are developed in the pregnancy. As such this research focuses on the care process for pregnant women, from the start of their pregnancy up until giving birth. In this thesis this is referred to as *perinatal care* (see also Chapter 4).

Perinatal care is studied in the Netherlands. The Dutch perinatal care system is unique in the world. It is organized as a tiered system: midwifery practices, specialized in delivering *care*, are responsible for low-risk pregnancies and obstetric departments in hospitals, specialized in delivering *cure*, are responsible for high-risk pregnancies. In addition, whereas with many *care-cure* conditions only recently awareness is raised for the psychosocial aspects, for the *care* aspects, the Dutch perinatal care system is known for its midwifery model of care, which has a strong focus on *care*. More on the rationale for chosen Dutch perinatal care is provided in Chapter 3. The Netherlands has a tiered system for perinatal care and as such, the terms midwifery care and obstetric care are more often used than perinatal care. However, since this research concerns the care for pregnant women from the start up until giving birth, regardless of the organization that delivers the care, the more neutral term “perinatal care” is chosen.

1.3.3 Operations Strategy and Operations Management

This research applies an operations strategy and operations management perspective, focusing on inter-organizational designs and their effect on the care process for patients. Although operations management and operations strategy are often discussed at the level of an organization, it also applies to the inter-organizational level; since decades the field is moving beyond organizational boundaries into the supply chain and into networks (Cousins, Lawson and Squire, 2006).

Operations management is concerned with the design, management and improvement of processes and production systems that create an organization’s output. The operations function comprises all the activities that are involved in the transformation of inputs into outputs, thereby realizing the products that are the reason for the organization’s existence. As such, the operations function is responsible for fulfilling customer requirements throughout the production and delivery of goods and services (Slack, Chambers and Johnston, 2010).

Whereas operations management is focused on the tactical or operational level, operations strategy is focused on the strategic level. Operations strategy (or manufacturing strategy) refers to the strategy regarding the design, management and improvement of processes and

production systems that create an organization's output (Slack, Chambers and Johnston, 2010), which comprises all the activities that are involved in the transformation of inputs into outputs. This is also called the "manufacturing task" as defined by Skinner (1974), who states that the "manufacturing task" is the translation of "what it means to manufacturing" of the business strategy of an organization (Van Dierdonck and Brand, 1988; Skinner, 1974).

Proper strategic positioning or aligning of operational capabilities can significantly impact competitive strength and business performance of an organization (Anderson, Cleveland, & Schroeder, 1989). It is a well-established notion that better operational/organizational performance may be expected if the business strategy and the operations strategy of an organization fit closely together (Gupta and Lonial, 1998; Swink and Way, 1995; Anderson, Cleveland and Schroeder, 1989; Kotha and Orne, 1989). Although there are different ways to define what a business strategy is (Kotha and Orne, 1989; Beard and Dess, 1981), it seems reasonable to use it to refer to questions concerning what business an organization should compete in. However, this does not imply that the only task of the operations strategy is to fulfill the business strategy. On the contrary, the operations strategy can have an input to the business strategy. An example is the concept of focus, which states that an organization can achieve superior performance by focusing on one particular product, market or process (Skinner, 1974). In addition, the operations strategy has some important trade-off decisions to make regarding the organization and management of an organization, such as job specialization, supervision, and group size of staff (Skinner, 1969). This all does not only apply to manufacturing firms, but also to the service sector (Smith and Reece, 1999).

Service Sector

From the early days, operations strategy focused on the manufacturing sector, on the production of goods. However, since the 1970's more and more attention is paid to services. At first, concepts from the manufacturing world were applied to the service sector directly, but soon it became clear that the service sector differs fundamentally from the manufacturing sector and that concepts from the manufacturing sector cannot be applied to services overnight (see for an overview Chase and Apte, 2007; Johnston, 1994). Differences between goods and services are that services have an intangible nature, the customer participates in the production process, production and consumption occur often simultaneously, services cannot be checked prior to their delivery, and services cannot be inventoried (Sampson, 2000; Duclos, Siha and Lummus, 1995; Silvestro, Fitzgerald, Johnston and Voss, 1992; Hill, 1991). These differences have an effect on the design, management and improvement of service systems compared to production systems, which have led to the development of specific service concepts, such as the customer contact model (Chase, 1978), the SERVQUAL gap model (Parasuraman, Zeithaml and Berry,

1985), and a typology of service classifications (Silvestro, Fitzgerald, Johnston and Voss, 1992; Schmenner, 1986; Lovelock, 1983).

Healthcare

Healthcare processes, being service processes, remain fundamentally different from most manufacturing processes on other aspects than mentioned above for services. Firstly, the "units" that flow through a healthcare process are real humans, who participate in the process at the same time (Iedema et al., 2008). Secondly, in most manufacturing processes, the overriding goal tends to be to process as many good quality items as possible in as short a time as possible, whereas the main goal in a health delivery system must be to improve the health of a population. Processing more patients per time unit may not directly affect their health. Thirdly, where manufacturing focuses on profitability, the objective of healthcare systems is to eliminate or alleviate illness (Horvath, 1975). Healthcare is a professional service, characterized by a high degree of interaction and customization and by a high degree of labor intensity (Silvestro, Fitzgerald, Johnston and Voss, 1992; Schmenner, 1986; Maister and Lovelock, 1982).

1.4 Outline of the Thesis

The research objective of this thesis is: *What inter-organizational design would work best for care-cure conditions, so that patients' needs are met, and that problems due to fragmentation are overcome?* The first step is to conduct a literature review. What inter-organizational designs for *care-cure* conditions are currently in place, what problems do these designs face and which solutions are out there? A closer look at those solutions will teach us that what they have in common is that they focus on improving inter-organizational collaboration. This is presented in Chapter 2. The literature is ambiguous regarding what inter-organizational design would work best. However, there is consensus on the major importance of inter-organizational collaboration in improving healthcare. As such, this research focuses on the intersection of inter-organizational design, inter-organizational collaboration and patients' flow, health and wellbeing.

Chapter 3 presents the research design and the methods used. This research applies a mixed methods approach and aims to contribute to the development of theory regarding inter-organizational design in healthcare. This is done through a combination of case study research (Eisenhardt, 1989) and simulation (Davis, Eisenhardt and Bingham, 2007). Dutch perinatal care is chosen as the case setting and the simulation method used is system dynamics. The case study consists of three phases. In order to answer the research question for Dutch perinatal care, firstly, one has to gain insight into the current inter-organizational

design and its problems (what-question), secondly, one has to understand what causes the problem (why-question), before thirdly, one can improve the system (how-question).

Chapter 4 and Chapter 5 describe the first phase of the case study. Chapter 4 describes the structure of Dutch perinatal care (midwifery practices are responsible for low-risk pregnancies and obstetric departments in hospitals are responsible for high-risk pregnancies), the problems that Dutch perinatal care faces, the root causes underlying these problems that are mentioned in the literature and in the news, and some solutions that the field is focusing on. Chapter 5 digs deeper in on one of the causes of the problems in Dutch perinatal care: its structure. An in-depth archival data-analysis of the problems regarding its structure is conducted. The inter-organizational *design* of the system is compared with the inter-organizational *practice*, and it appears that the system does not operate according to its design.

Chapter 6 focuses on the second phase, on what causes the problems in Dutch perinatal care, on why it is not operating according to its design and on why this situation persists. In searching for the 'why', this research focuses on inter-organizational collaboration, as is more or less proposed by the literature review.

Chapter 7 describes the third phase, which focuses on evaluating new inter-organizational designs for Dutch perinatal care that are currently being implemented. A simulation model is developed which focuses on the dynamics of inter-organizational collaboration and competition in a tiered healthcare system. Based on this, conclusions are drawn on how to improve Dutch perinatal care.

In the final chapter, the insights from the case study and the simulations are brought together and recommendations are made for Dutch perinatal care and for perinatal care systems in other developed countries. The system dynamics model, which is grounded in the case study, is this research's only real claim to generalizability. As such, recommendations will be made regarding inter-organizational design for *care-cure* conditions.

1.5 Guidelines for the Reader

Although several chapters of this thesis have been published separately, this thesis aims to be more than a collection of related papers. It aims to tell a story, to be a coherent entity, with a beginning and an end. For those who do not have the time or the interest to read the whole thesis, Table 1-1 provides some guidelines on what might be interesting for you to read, depending on your interests.

Table 1-1 Guidelines for the reader

Interest in:	2. Literature Review	3. Research Design and Methods	4. Dutch Perinatal Care (DPC)	5. Limits to the Design of DPC	6. Inter-Organizational Collaboration in DPC	7. Evaluating Inter-Organizational Designs in DPC	8. Discussion and Conlusions
Care-Cure Conditions	X						X
(Dutch) Perinatal Care			X	X	X	X	X
Group Model Building		3.6*			X		
Integrated Care	X				X	X	X
Inter-Organizational Collaboration	X				X	X	X
Operations / Strategic Management		3.5*		X		X	X
Organizational Change		3.6*			X		
Research Methods		X					
System Dynamics		3.7*				X	

* in particular Section....

Chapter 2.

Inter-Organizational Designs for *Care-Cure* Conditions

A Literature Review

2.1 Introduction

As is described in the introduction of the first chapter, one root cause for problems in healthcare is the design of the services provided. Historically, healthcare services were designed functionally and geographically. Unfortunately, this resulted in fragmented, poorly coordinated care and low service quality. Nowadays, healthcare services are more and more designed from the perspective of the patient, around the patients needs.

This research focuses on the needs of a specific category of patients: those with a *care-cure* condition (Section 2.2). This literature review regarding inter-organizational designs for *care-cure* conditions is organized around the following questions.

A. *What inter-organizational designs can currently be found in practice for care-cure conditions?*
B. *What are the problems of the current inter-organizational designs?*
C. *What solutions are being put in place?*
D. *What are the underlying assumptions of these solutions?*

Section 2.3 presents past and current inter-organizational designs for *care-cure* conditions. Section 2.4 describes the problems that are associated with the current inter-organizational designs. Section 2.5 focuses on the solutions that are being put in place. Finally, the underlying assumptions, the common ground of the solutions – improving collaboration between professionals and organizations – are explored in more detail in Section 2.6.

The designs presented concern only adult patients, the design for children and the problems that arise regarding the provision of care when children become adults are not described here (see for example Singh et al., (2008) on the transition from child to adult mental health services in the United Kingdom). The examples used to describe the main inter-organizational designs are taken from the United Kingdom, The Netherlands, and the United States. These three countries are chosen because while they are all developed countries, their healthcare policy and financial structures differ, which results in different structures, in different inter-organizational designs. The United Kingdom has a publicly funded healthcare system where most care is provided by the National Health Service (NHS). The Netherlands has a system where primary and secondary care (i.e. doctors and hospitals) are financed through private obligatory health insurance, and where long term care for elderly and long term mentally ill is covered by social insurance from taxation. Hospitals and insurance companies are privately health and not-for-profit. The United States is known for its mixed model: some health insurance is government based, others is private. Healthcare organizations are either private or owned by federal, state, county or city governments. Healthcare organizations and insurers can either be for-profit or not-for-

profit. As one will notice below, different inter-organizational designs for a certain condition can exist within one country and even within one region or city.

2.2 Defining Care and Cure

2.2.1 Care and Cure in the Literature

Care and cure are used in the literature and in practice in a variety of ways. They are discussed here in four different meanings: referring to activities, to attitudes, to organizations, and to sectors. Firstly, caring and curing are seen as two different *activities*: caring refers to nursing, as in what nurses and other allied health professionals traditionally do. Curing refers to the process of examining, diagnosing and treating illness, as in what physicians traditionally do (Glouberman and Mintzberg, 2001; Baumann et al., 1998; Webb, 1996; Jecker and Self, 1991). Caring is concerned with meeting the psychological and emotional needs of patients, curing is less concerned with the patient's emotional state and is more concerned with the condition itself (Linn, 1975). Some state, however, that care and cure should ideally be used by all healthcare providers, rather than being characteristic to different clinical professionals (Baumann et al., 1998).

Secondly, care and cure are defined as *attitudes*. Cure-oriented attitudes versus care-oriented attitudes in medicine have been referred to as 'the two faces of medicine' (Bensing, 1991). As such, two different styles in doctor-patient communication can be discerned (De Valck et al., 2001). The traditional, doctor- or disease-centered style is characterized by an authoritarian relationship in which the patient fulfills a passive role and the doctor embodies medical expertise. This doctor-centered approach stems from the biomedical model which is focused on treatment of physical symptoms and as such reconciles with a cure-oriented attitude. The last decennia a more bio-psycho-social model emerged, which focuses on psychological and social as well as physical symptoms (Engel, 1977). In this model, the physician tries to enter the patient's world through the patient's eyes (Mc Whinney, 1985). This more patient-centered approach requires a care-oriented attitude. Thus, cure-oriented attitudes reflect the instrumental, task-oriented dimension in the medical profession, whereas care-oriented attitudes relate to the affective dimension of the medical encounter (Webb, 1996; Bensing, 1991).

Thirdly, within the healthcare sector, care and cure can coincide with different *organizations*. Care organizations provide care to people who are terminally ill and thus will never recover from their specific malady or maladies (palliative care organizations). Cure organizations assume that after the delivery of care over some period of time the patient will recover, hopefully to a normal healthy state (Wickramasinghe and Davison,

2004). Another way of discerning care and cure organizations is the following (Glouberman and Mintzberg, 2001). Cure refers to the acute care hospitals, to secondary care. Care refers to organizations in primary care, where professionals such as general practitioners, dieticians, physiotherapists, and midwives work, and to alternative health services such as chiropractics and acupuncture.

Fourthly, care and cure are used to refer to certain *sectors*. Cure refers to the healthcare sector, to the medical world, and care refers to community, social and housing services (Kodner and Spreeuwenberg, 2002; Hardy et al., 1999).

What these different uses of care and cure have in common, is that they are defined in terms of the professionals, the type of organization, or the type of sector. This is in line with the traditionally organization and design of healthcare services, since they are designed from the organizations and the professionals' point of view. However, as is discussed in Chapter 1, healthcare services should be designed from a patient's perspective, taking into account the patients needs. In addition, the healthcare providers' roles are changing. Traditionally cure is delivered by physicians with a 'curing attitude' and care is delivered by nurses with a 'caring attitude'. But nowadays, there is a blurring of the care-cure continuum among physicians, nurses, and other healthcare providers including family members and the patient. The skills required to conduct all the activities that meet the patient's needs do not clearly fall within the domain of any health profession, particularly because they require not only technical knowledge, but also the interpersonal skills to be effective in empowering patients and their families (Baumann et al., 1998). Therefore, this research defines the terms care and cure slightly different than is done elsewhere. In this research, *care* and *cure* refer to the patient, to the patients' needs.

2.2.2 Defining Care-Cure Conditions

This research focuses on *care-cure* conditions. These conditions have in common that patients have needs at three levels (see Figure 2-1). Most of the time, the needs of patients can be met by self-management, by monitoring their condition by themselves. Secondly, patients have needs regarding general, preventive monitoring, education, psycho-sociological support, basic medical support, etcetera. We will call this need a need for *care*. Thirdly, in case of an episode, patients need specialized, medical intervention, what we will refer to as a need for *cure*.

Thus patients need a combination of *care* activities and *cure* activities. Not only do most chronic conditions fit this category, also some mental health disorders (such as depression) and pregnancy do (see Framework 2-1). *Care* and *cure* can be delivered by the same professional, although, in the highly specialized practice of healthcare, they are mostly delivered by different professionals. For diabetes, a specialized diabetes nurse is an

example of a *care* professional, whereas the vascular surgeon is an example of a *cure* professional.

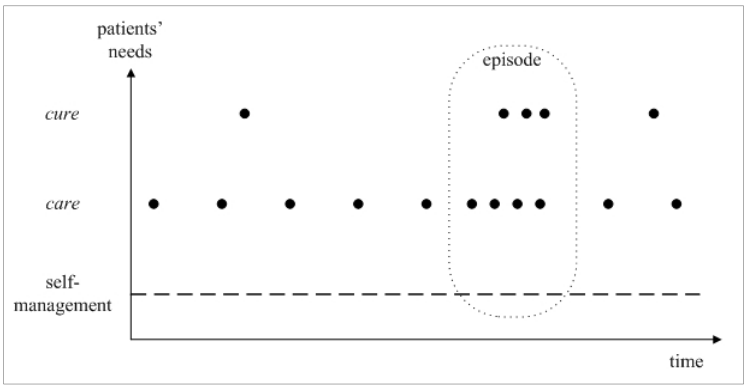

Figure 2-1 Patients' needs

Note that the difference of *care-cure* conditions as defined in this research with conditions that require first a medical intervention (*cure*), followed by a recovering process (*care*), such as is the case with elective surgery, knee implants, and orthopedics care. Here, the *cure* and *care* needs of the patient are met one after another, whereas with *care-cure* conditions, as is defined in this research, the *care* and *cure* needs are met in alternation to the patient.

Framework 2-1 Various *Care-Cure* Conditions

"Chronic Obstructive Pulmonary Disease (COPD) is not one single disease but an umbrella term used to describe chronic lung diseases that cause limitations in lung airflow. The most common symptoms of COPD are breathlessness, or a 'need for air', excessive sputum production, and a chronic cough. However, COPD is not just simply a "smoker's cough", but an under-diagnosed, life threatening lung disease that may progressively lead to death" (WHO, 2012a).

Diabetes is a chronic disease that occurs when the pancreas does not produce enough insulin, or when the body cannot effectively use the insulin it produces. Hyperglycemia, or raised blood sugar, is a common effect of uncontrolled diabetes and over time leads to serious damage to many of the body's systems, especially the nerves and blood vessels (WHO, 2012b).

The most common *mental health disorders* are depression, psychosis and bipolar disorders, and epilepsy. Mental health is defined as a state of well-being in which every individual realizes his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to her or his community (WHO, 2012c).

Cardiovascular diseases (CVDs) are a group of disorders of the heart and blood vessels, which include coronary heart disease (disease of the blood vessels supplying the heart muscle),

cerebrovascular disease (disease of the blood vessels supplying the brain), peripheral arterial disease (disease of blood vessels supplying the arms and legs), rheumatic heart disease (damage to the heart muscle and heart valves from rheumatic fever, caused by streptococcal bacteria), congenital heart disease (malformations of heart structure existing at birth), deep vein thrombosis and pulmonary embolism (blood clots in the leg veins, which can dislodge and move to the heart and lungs) (WHO, 2012d).

This research does not prescribe the type of professional or the kind of organization that should meet the *care* and *cure* needs. It does not prescribe that *care* needs should be met solely by nurses or *cure* needs by physicians, nor that *care* needs should be met in primary care or *cure* needs in secondary care. In line with how *care* and *cure* are defined in this research, wherever this research refers to "delivering *care/cure*", actually "meeting the *care/cure* needs of the patients" is meant.

2.3 Inter-Organizational Designs for *Care-Cure* Conditions

2.3.1 Acute Care Model

Traditionally, healthcare was mostly delivered according to the "acute care" model (Bodenheimer, Wagner and Grumback, 2002; Wagner et al., 2001a). It is specialist healthcare, focused on *cure*, on medical intervention, often delivered in hospitals, in secondary care. An example is the care process for COPD patients as can be found in the United States. Here, health professionals and patients seldom interact except during episodes of acute illness (Fromer, 2011; Zuwallack and Nici, 2010). Responsibility for problem solving is directed to the clinician and the responsibility for daily chronic-care management is directed to the patient, typically without self-management support (Cramm, Rutten-Van Molken and Nieboer, 2012). The perspective of COPD in the United States is that of a disease treatment with a focus primarily on biomedical concerns and less attention to psychosocial dynamics or needs beyond those of the acute admission (Simpson and Rocker, 2008). Other examples of the "acute care" model are mental healthcare in the Netherlands (Van der Feltz-Cornelis, 2011; Peters, De Leeuw and Schrijvers, 2010) and in the United Kingdom (Chew-Craham et al., 2007). In addition, in the Netherlands, diabetic care has been organized according to this model for a long time. (Eijkelberg et al., 2001).

In the last decade there is growing awareness of the value of *care*, of the psychological aspects and of the value of prevention of *care-cure* conditions (Simpson and Rocker, 2008; Peeples and Seley, 2007; Rothman and Wagner, 2003), as can be found here and there with COPD in the United States (Simpson and Rocker, 2008). It is more and more recognized that healthcare can be improved by refocus toward proactive maintenance. Care must reach beyond healthcare organizations into patients' lives in the community (Fromer, 2011;

Voelkel, 2000) and patients should be given increased responsibility for the day-to-day management of their disease (Cramm, Rutten-Van Molken and Nieboer, 2012; Peeples and Seley, 2007; Rothman and Wagner, 2003; Glasgow et al., 2001).

2.3.2 Focused Factory Concept

As a result of a shifting focus from only *cure* to *care* and *cure,* new designs for healthcare delivery are being developed. One notion from the operations management/strategy literature has exercised great appeal on the healthcare sector: the focused factory concept.

The Focused Factory Concept in Manufacturing

Skinner (1974) introduced the concept of the focused factory into the operations strategy vocabulary. He based his concept on the intuitive notion that a plant can achieve superior performance by organizing its resources to perform one task instead of trying to meet all sorts of demands from internal and external sources. As a result, a focused factory with a narrow product mix for a particular market niche will outperform the conventional plant, which has a broader scope. As an organization chooses to highlight one particular set of service or market demands (by either separating it from other parts of the organization or by deliberately growing that part of the business at a rate larger than other firms), it can begin to better align its process and infrastructural elements on this new area of focus. Such "focused factories" allow for a disproportionate increase in repetition and experience in this set of activities, which in turn affects learning, and, ultimately, results in improved organizational performance (McDermott, Stock and Shah, 2011; Mclaughlin, Yang and Van Dierdonck, 1995).

What a factory should focus on is not always clear (Bozarth, 1993). Skinner defined three dimensions of focus: product, market and process focus. Some authors have stated that a factory should focus along one or two of these dimensions (Swamidass, 1991), others have said that these three dimensions are not independent from one another and that they should not be managed separately: each plant should be focused along all these dimensions (Ketokivi and Jokinen, 2006). Moreover, a fourth dimension might be a focus on flexibility (Collins, Cordon and Julien, 1998). Two different configurations of focused factories can be distinguished (Skinner, 1974). One configuration is that a factory focuses on one particular product-market-process combination. A second configuration is that a factory focuses on multiple product-market-process combinations, as long as each of these is organized separately according to the focus principle. This is also known as the "plant-within-a-plant" configuration (Hayes and Wheelwhight, 1984; Skinner, 1974).

The effectiveness of the focused factory concept has been researched extensively in manufacturing industries. It has been established that focused factories have fewer final products with more standardization and less variations, have better process flows enabling

more automation, have a better performance than unfocused ones and score better on costs, quality, dependability, speed, profitability levels, returns, and growth (e.g. Vokurka and Davis, 2000).

Over the past 25 years, the intuitively appealing principle of organizational focus has been employed successfully in the service industry (Van Dierdonck and Brandt, 1988) and in the healthcare sector (Mclaughlin, Yang, and Van Dierdonck, 1995).

The Focused Factory Concept in Healthcare

According to its main advocate, Herzlinger (2004; 1997), the *entire* existing healthcare system should be replaced by a system of focused factories, ranging from those who provide only one procedure (see Framework 2-2), to those that provide the full panoply of care for specific diseases (mostly chronically diseases, such as cancer). They can range from those serving the needs of most of us, to those specializing in very complex patients. A system that separates customers by the uniqueness of their needs makes good economic sense, Herzlinger argues. It creates a more efficient healthcare delivery system. These 'focused factories' will provide better-quality healthcare, at lower costs, and with higher patient satisfaction. Herzlinger therefore advocates the establishment of these 'focused factories' on a wider scale. Incidentally, most of them are for-profit organizations, owned by physicians, often jointly with a local hospital, or with a firm specialized in such facilities (Casalino, Devers and Brewseter, 2003).

Basically, two main designs can be discerned: a design based on organizational separation, where *care* and *cure* are provided by different organizations, and a design based on organizational integration, in which both *care* and *cure* are provided by one organization. These two designs will be discussed below in more detail. Note that these different designs can co-exist within one country and within a geographical region, as is for example the case with diabetic care, where there is a large variety in the organization of the care process: in primary or community care facilities, in hospitals and in specialized clinics in hospitals (Borgermans et al., 2008).

Framework 2-2 Herzlinger on Diabetes

When Herzlinger applies the focused factory concept to diabetes, then "ideally you would have somebody who interacts with patients daily to help them monitor and manage their insulin glucose levels. You'd have dialysis centers in convenient community locations because a big co-morbidity of diabetes is kidney disease. You'd have pharmacists who would enable diabetics to monitor their disease status and who would know the patients and give them information and encourage them in dealing with this terrible disease. You'd have specialty hospitals that did things like kidney or pancreas transplants or eye surgery. Unfortunately, all too many diabetics find that their feet or some part of their leg may become gangrenous because of impairment in circulation. You'd have people who do amputations. What characterizes the system is that it exists in many geographic sites, wherever customers need help." (Herzlinger, 1998, p3).

2.3.3 Organizational Separation of Care and Cure

As it becomes more recognized that the delivery of *care* is important for *care-cure* conditions, the "acute care" model, as described before, transforms to a design in which *care* and *cure* are delivered by different organizations, which often aligns with the distinction between primary and secondary care (see Framework 2-3). Primary care is involved in the prevention, diagnosis and treatment of the disease in chronic and stable phases, it focuses on delivering *care*. In case of specialist examination or inpatient treatment in acute phases of the disease, patients are referred to secondary care, which focuses on delivering *cure* (Chin et al., 2000). This is for example the case with COPD in the Netherlands and the United Kingdom (Cramm, Rutten-Van Molken and Nieboer, 2012; Utens et al., 2012), and with diabetic care in the Netherlands (Van Dijk et al., 2011; Eijkelberg et al., 2001) and the United Kingdom (Audit Commission, 2000; Khunti and Ganguli, 2000). Sometimes even a stepped care design is introduced, consisting of different levels of symptoms and corresponding levels of treatment, as is the case in mental healthcare in the Netherlands (Franx et al., 2009; Seekles et al., 2009; Meeuwissen et al., 2008) and the United Kingdom (Home Office, 2010; Gask et al., 2008; Bindman et al., 1997). Even though primary care is rather undeveloped in the United States (Wilcos, Lewis and Burgers, 2011), it is expected that the future of chronic illnesses in the United States is not in secondary care but in primary care (Rothman and Wagner, 2003). Expertise in behavioral change and self-management support is central to successful care. Primary care clinicians, especially more recent graduates, usually have more training in these areas than specialists (Rothman and Wagner, 2003).

Not only is *care* introduced in primary care, also some *cure* that previously has been done in secondary care is transferred to primary care (Scott, 1996). Often, chronic diseases have a broad spectrum of severity, with most patients at the less severe end. For these patients, primary care practitioners can readily meet the clinical (i.e. *cure*) needs. Only those patients that require more complex care may benefit from a transfer to specialist care. In addition,

most adults have more than one chronic condition, which results in an increased need for care coordination. These patients may benefit from primary caregivers who have more general training and clinical experience (Rothman and Wagner, 2003). Within this design there are still various degrees of freedom. Care can be delivered in a centralized multidisciplinary team, as is for example the case in diabetic care in the United States, that integrates the skills of practitioners from different disciplines, all practicing under one roof: generalist and specialist physicians, registered nurses and nurse practitioners, physician assistants, certified diabetes educators, dietitians, and, possibly, pharmacists (Rodriguez and Miranda-Palma, 2011; Bankard et al., 2009). On the contrary, professionals with various skills can work more or less independent from each other in independent organizations. Also, professionals can specialize in a certain condition, as midwives or specialized nurses do, or be more generalists, as general practitioners are.

Framework 2-3 Primary and Secondary Care

Primary care relates to the professional care received in the community, for example from general practitioners, nurse practitioners, midwives, dentists, physical therapists, dieticians, and pharmacists. It covers a broad range of health and preventative services, including health education, counseling, disease prevention and screening (King, 2001). Primary care is aimed at patients staying at home and is provided as close to the patient's home as possible and, if necessary, at the patient's home. It is accessible to all, irrespective of the nature of their health problems. The system is able to respond to urgent cases, providing immediate access where necessary (Health Council of the Netherlands, 2004). Secondary care consists of medical specialists that focus on medical diagnostics and interventions, often delivered in hospitals. In some countries, for example in the Netherlands and in the United Kingdom, primary care is solid developed, whereas the United States has a rather undeveloped primary care (Wilcox, Lewis and Burgers, 2011).

In general, there are several arguments in favor of a healthcare system with a strong primary care component. Firstly, by strengthening primary care, capacity is freed in secondary care, as low-risk patients are taken care of outside of hospitals (Wilcox, Lewis and Burgers, 2011) and because primary care acts as a gatekeeper to secondary care, it prevents unnecessary demand on secondary care (Wilcox, Lewis and Burgers, 2011; Health Council of the Netherlands, 2004). Secondly, a relation is found between strong primary care and a better population health status (Starfield, Shi and Macinko, 2005; Health Council of the Netherlands, 2004). And thirdly, having strong primary care it is expected to result in lower costs (Health Council of the Netherlands, 2004).

Still, some state that the interface between primary and secondary care needs to be improved (Kvamme et al., 2001) and some even propose merging primary and secondary care (Vuorenkoski and Wiili-Peltola, 2007).

2.3.4 Organizational Integration of Care and Cure

The second main design that evolved as a result of a shifting focus from only *cure* to *care* and *cure,* is the design where *care* and *cure* are delivered by one organization, as is for example the case with the specialty clinics for diabetic care in the United Kingdom (Nocon et al., 2003) and in the United States (Bratcher and Bello, 2011; Bankard et al., 2009).

Some state that secondary care, instead of primary care, is more suitable for taking care of both the *care* and *cure* needs of patients with *care-cure* conditions. There is a growing body of evidence demonstrating that specialists are more knowledgeable about the management of conditions associated with their specialty, more aware of guidelines delineating such management, and more likely to use tests and medications in accordance with guidelines. Evidence also suggests that specialists more quickly change practice to adjust to new developments (Rothman and Wagner, 2003). As a result, specialist organizations expand the services they deliver, in the number of physicians, the length of interaction, and the type of services they deliver (Rothman and Wagner, 2003). Two different forms emerge: the standalone organization, also called specialty hospitals or specialized clinics that exist outside regular hospitals, and the service lines that are created within existing hospitals.

Specialty hospitals or specialized clinics or organizations that exist outside regular hospitals focus on a narrow market. One of the earliest and well-known examples of such a configuration is Shouldice hospital in Canada, which has long been fully dedicated to the surgical repair of external abdominal wall hernias without complications (Urquhart and O'Dell, 2004). Other examples can be found in orthopedic surgery (Cram et al., 2007), cardiac surgery (Cram, Rosenthal and Vaughan-Sarrazin, 2005), diabetes (Wagner et al. 2001b), and vision (EAEH, 2008). In the United States, the number of specialty hospitals has tripled between 1990 and 2003, and the number of ambulatory surgery centers has doubled between 1991 and 2001 (Shactman, 2005).

Also, there is the concept of focus or specialization within a hospital, which refers to Skinner's service lines, to the plant-within-a-plant configuration. This is especially appealing to acute care general hospitals, since they are not allowed to reduce the range of medical services. As such, a hospital places a strategic emphasis on a clinical area (McDermott, Stock and Shah, 2011). It is now even common to see billboards touting one general hospital in a local market as a "leader" for some specific medical condition. Results show that such focus is associated with lower costs and with higher performance (McDermott, Stock and Shah, 2011).

2.4 Problems of Current Inter-Organizational Designs

The above described designs come with some problems. Firstly, when *care* and *cure* are delivered by different organizations, care processes are often fragmented and problems of coordination regarding the patient's condition arise. Poor quality of care due to coordination problems between primary and secondary care is often reported. Many patients feel they are left "in limbo" when moving from one part of the system to another (Wadmann, Strandberg-Larsen and Vrangbæk, 2009; England and Lester, 2005; Preston et al., 1999). Each part tends to focus on its own tasks and resources and not at the system as a whole, that is, the system actually experienced by patients. So the task of improving the quality of interaction, cooperation and communication across the interfaces is not seen as any group's particular responsibility (Kvamme et al., 2001). For example, in Dutch diabetic care, patients faced on average just over four healthcare providers, and therefore coordination of care is of great importance (Van Dijk et al., 2011). In addition, some organizations are not aware what other organizations are doing, which might result in duplicative care, as is the case in diabetic care in the United States (Glasgow et al., 2001) or in referring patients to the wrong organization, as is the case in mental healthcare in the United Kingdom (Gask et al., 2012). Thus meeting the needs of patients requires the collaboration of a group of healthcare professionals, working together across disciplinary and organizational boundaries (Department of Health, 2003; Bindman et al., 1997).

Secondly, when professionals do not specialize in a particular condition, as is the case with practice nurses and general practitioners, the knowledge of a particular condition is often lacking. For example, COPD has only been a minority interest in primary care and professionals lack the right knowledge, both in the United Kingdom (White, 2005) and in the United States (Barr et al., 2005). However, when professionals and organizations are specialized in a particular condition, this can cause problems for co-morbidity patients (i.e. patients with more than one, often chronic, condition) (Johnson et al., 2012).

Thirdly, organizations that deliver both *care* and *cure*, i.e. specialty hospitals, might seem attractive since some studies have found that these specialty hospitals have a higher medical performance than general hospitals (Kc and Terwiesch, 2011; McDermott, Stock and Shah, 2011; Cram et al., 2007; Barro, Huckman and Kessler, 2006; Cram, Rosenthal and Vaughan-Sarrazin, 2005; Yang et al., 1992). However, there are also doubts on their medical performance (Guterman, 2006; Shactman, 2005; Casalino, Devers and Brewster, 2003), and on their costs (Cram, Rosenthal and Vaughan-Sarrazin, 2005; Dummit, 2005).

Fourthly, when *care* and *cure* are delivered by different organizations, practice is often different from what is written down on paper. Staff members often do not understand their own role or the role of others, as is the case in diabetes care in the United Kingdom

(Mohiddin, Naithani and Gulliford, 2006) and each organization tends to focus on its own tasks and resources and not at the system as a whole, that is, the system actually experienced by patients. So the task of improving the quality of interaction, cooperation and communication across the interfaces is not seen as any groups' particular responsibility (Kvamme et al., 2001).

Finally, one should not only take the effects of organizations of its own in consideration; organizations have an effect on each other. For example, the introduction of organizations that specialize in delivering both *care* and *cure*, i.e. specialty hospitals, might have an indirect negative impact on general hospitals. After all, these general hospitals are left with the rest of the population, who are often more sick, as well as with less profitable procedures, because specialty hospitals attract the relatively healthy patients and can concentrate on providing profitable procedures (Barro, Huckman and Kessler, 2006; Fahlman and Chollet, 2006). In addition, having specialists (*cure* specialists) taking on *care* tasks creates more competition, especially with primary care (Rothman and Wagner, 2003). Although the entry of specialty hospitals to the healthcare market may be too recent to determine their longer-term effects on general hospitals (Fahlman and Chollet, 2006).

2.5 Solutions

There are several initiatives in place that try to overcome the problems of fragmentation and coordination, and that try to integrate the delivery of *care* and *cure.* An integrated care service is defined as a coherent and coordinated set of services which are planned, managed and delivered to individual service users across a range of organizations and by a range of co-operating professionals and informal carers (Minkman et al., 2011). There is a large variety of initiatives in integrating care and there is a myriad of definitions and concepts (see Framework 2-4). Systematic understanding of "integrated care" and the related notions has been greatly hampered by a lack in specific and clarity, with commonly used definitions to be vague and confusing (Kodner and Spreeuwenberg, 2002).

Basically, all the initiatives focus on improving outcomes for a target population (Ovretveit, 1998), by improving coordination, communication and collaboration between care providers and/or professionals, by integrating services. These initiatives all differ regarding to the type of integration (functional, organizational, professional or clinical), the breadth of integration (horizontal or vertical), the degree of integration (linkage, coordination or integration) and the process of integration (see also Framework 2-5) (Nolte and McKee, 2008). Despite all the variations, integrated care structures rarely integrate the actual delivery of *care* and *cure* (Burns and Pauly, 2002), they focus more on administrative and organizational integration. In order to achieve collaboration on a patient level, focus should

be on the health professionals, on their collaboration, on their behavior (Van Wijngaarden, De Bont and Huijsman, 2006).

Framework 2-4 Examples of Integrated Care

- Disease Management (Wagner, 1998)
- Chronic Illness Care Model (Wagner et al., 2001a; Wagner et al., 1999)
- Integrated care (Kodner and Spreeuwenberg, 2002)
- Transmural care (Van der Linden, Spreeuwenberg and Schrijvers, 2001)
- Shared care (Mur-Veenman, Eijkelberg and Spreeuwenberg, 2001; Hickman, Drummond and Grimshaw, 1994)
- Care pathways (Campbell et al., 1998)
- Integrated delivery networks (Burns and Pauly, 2002)
- Inter-organizational networks (Barretta, 2008).

Framework 2-5 Variations in Integration

"The literature differentiates different *types of integration*. Functional integration (extent to which key support functions and activities such as financial management, human resources, strategic planning, information management and quality improvement are coordinated across operating units), organizational integration (e.g. creation of networks, mergers, contracting or strategic alliances between healthcare institutions), professional integration (e.g. joint working, group practices, contracting or strategic alliances of healthcare professionals within and between institutions and organizations) and clinical integration (extent to which patient care services are coordinated across the various personnel, functions, activities and operating units of a system).

The breadth of integration. This refers to the range of healthcare services provided. Horizontal integration takes place between organizations or organizational units that are on the same level in the delivery of healthcare or have the same status; vertical integration brings together organizations at different levels of a hierarchical structure.

The degree of integration. This ranges from full integration, that is the integrated organization is responsible for the full continuum of care (including financing), to collaboration, which refers to separate structures where organizations retain their own service responsibility and funding criteria.

The process of integration. This distinguishes between structural integration (the alignment of tasks, functions and activities of organizations and healthcare professionals), cultural integration (convergence of values, norms, working methods, approaches and symbols adopted by the (various) actors), social integration (the intensification of social relationships between the (various) actors and integration of objectives, interests, power and resources of the (various) actors."

(Nolte and McKee, 2008, p.71)

2.6 Collaboration

A closer look at solutions as described above, teaches us that what they have in common is that they all focus on improving collaboration, between professionals and between organizations. This section presents insights regarding collaboration from different fields of the literature such as operations management, healthcare management, organizational science, and service management.

2.6.1 Level of Collaboration

Collaboration is studied at different levels. Firstly, there is the distinction of collaboration on the *micro* and on the *macro* level. The micro level focuses on collaboration within an organization, among individuals, within teams (Bamford and Griffin, 2008) and among groups or departments. This is also referred to as intra-organizational collaboration or inter-professional teamworking. The macro level focuses on collaboration between organizations (Gitell and Weis, 2004), which is being referred to as inter-organizational collaboration. Secondly, there is the distinction of collaboration on a *personal* level, between persons, on a *group* level, between groups (Schopler, 1987), on a *role* level, between organizational roles with which individuals identify themselves with (Ring and Van de Ven, 1994), and collaboration on an *organizational/institutional* level, between organizational/institutional entities. Thirdly, collaboration between organizations can be *vertical* (buyer-supplier), *horizontal* (same industry) or *lateral* (different industries) (Nooteboom, 2004).

This research focuses on horizontal collaboration on a personal/role and macro level. It concerns collaboration in the healthcare sector between professionals from different organizations.

2.6.2 Importance of Inter-Organizational Collaboration

Inter-organizational collaboration is not only of importance to the healthcare sector, it is important in other sectors as well. For example, in the field of operations management, inter-organizational collaboration is becoming more and more important not only because of the competitive advantages – where business used to be about competitive firms, it is now more and more about competitive supply chains (Hult, Ketchen and Arrfelt, 2007; Buhman, Kekre and Singhal, 2005), but also from a quality perspective – managers should extend their vision beyond their own firms into the supply chain to manage quality (Carr et al., 2008; Foster, 2008). And already in 1997, Lee and Ng pointed to the importance of integration and coordination in enterprise networks: “The significant movement in industries such as apparel (quick response), grocery (efficient consumer response), food services (efficient food service response), and healthcare products (efficient health care consumer response) are examples of how companies in these industries seek to overcome

company and functional boundaries so that material, information and financial flows in the supply chain can be streamlined" (Lee and Ng, 1997, p 191).

2.6.3 Defining Inter-Organizational Collaboration

An inter-organizational relationship occurs when two or more organizations transact resources (money, physical facilities and material, customer or client referrals, technical staff) amongst each other (Van de Ven, 1976). There are different levels of collaboration within such an inter-organizational relationship: coordination, cooperation and collaboration. They are often confused with each other (Economist Intelligence Unit, 2008; Kinnaman and Bleich, 2004; Alter, 1990). They are complementary to each other as they consist of similar events (Arshinder and Deshmukh, 2008), but there are also differences (Kinnaman and Bleich, 2004). In coordination, people that separately provide services to a client or a program inform each other of their activities. Cooperation takes it a level up: people are actively working together for mutual benefit. Collaboration is even more extensive: it is marked by knowledge contribution, equal distribution of power, and a focus on achieving best outcomes without regard to discipline, hierarchy, or even organizational boundaries (Kinnaman and Bleich, 2004). Inter-organizational collaboration in this research is defined as the latter.

There are two more types of inter-organizational collaboration that needs to be mentioned: relational coordination and co-operation. Relational coordination is a mutually reinforcing process of interaction between communication and relationships carried out for the purpose of task integration, in which three dimensions are important: shared knowledge, shared goals and mutual respect (Gitell, 2012; Gitell and Douglas, 2012). Relational coordination is expected to be particularly important for achieving desired outcomes in settings in which multiple providers are engaged in carrying out highly interdependent tasks under conditions of uncertainty and time constraints, as is often the case in healthcare. Relational coordination focuses on coordination between roles instead of on coordination between individuals. It has the following dimensions: frequent communication, timely communication, accurate communication, problem solving communication, shared goals, shared knowledge, and mutual respect. It is developed and tested in the healthcare sector (Gitell, 2009; Gittell et al., 2008; Weinberg et al., 2007), but in other sectors as well (Bond and Gitell, 2010; Gitell 2001).

Healthcare organizations sometimes compete over the same patients. However, competition does not have to stand in the way of collaboration: coopetition might be a good option. Coopetition refers to simultaneously cooperative and competitive behavior. Coopetition is slowly gaining more popularity in the healthcare sector (Gee, 2000; Goddard and Mannion, 1998). Gee (2000) proposes that the United States should embrace the principles and practices of coopetition, and European countries are moving towards a more competitive

model (Barretta, 2008; Veer and Meijer, 1996). At the core of coopetition is the idea that by improving the overall system, all parties benefit (Gee, 2000). Cooperation is about increasing the size of the pie (or making a totally new pie), and then competing in cutting it up (Ritala, 2012; Brandenburger and Nalebuff, 1996). For example in healthcare, it is about establishing universal procedures, reduce complexity, increase understanding and develop user-friendly terminology and access (Gee, 2000). As such, a coopetition strategy is beneficial for an organization's innovation performance and creates value for the customer (Ritala, 2012). As with the integrated care initiatives as described in Section 2.5, collaboration forms the first step, but coopetition moves beyond collaboration in addressing fundamental issues and problems (Gee, 2000).

2.6.4 Formal versus Informal Collaboration

There are two generic forms of collaboration: voluntary collaboration and self-coordinating by the individuals themselves, and hierarchical arrangements using formal authority, policies and procedures to insure collaboration (Wren, 1961). This is also referred to as informal and formal collaboration (Smith, Carroll and Ashford, 1995; Wren, 1961). Informal collaboration involves adaptable arrangements in which behavioral norms rather than contractual obligations determine the contributions of parties. Informal collaboration arises spontaneously when under the following conditions: the parties' perceiving they will be in contact with each other for a long time, their believing it is to their advantage to cooperate, and their recognizing they must reciprocate for any benefits received, employing a tit for tat strategy (Axelrod, 1984). Formal collaboration is characterized by contractual obligations and formal structures of control. Formal types of cooperation can evolve over time into informal types in which rules and regulations are no longer needed (Ring and Van de Ven, 1994).

2.6.5 Drivers and Barriers to Collaboration

Research of inter-organizational relations suggests that these relations are too complex to grasp in terms of simple, linear effects from independent on dependent variables. Many variables are involved, and most of them influence each other in circular causality. The central reason for this is that enduring, fruitful relations are based on interaction and mutual dependence (De Jong et al., 1998). As such the aim of this literature review of drivers and barriers is to provide the reader with some more background and more general insights.

Individual Level

Several factors on the individual level play a role in inter-organizational collaboration. Firstly, there are differences between professionals. Professionals from different organizations often come from disparate backgrounds, and have dissimilar belief systems (Sutcliffe and Huber 1998). In healthcare, where a variety of professionals is involved in caring for the same patient, such as doctors, nurses, therapists, social workers and others,

functional boundaries between those professionals are reinforced by professional identities, specialized knowledge and status differentials, undermining relationships and making communication more difficult (Wicks, 1998). These differences can result in problems of understanding (Vlaar, Van den Bosch and Volberda, 2006). In a collaborative project, these differences are especially enlarged by the dynamics of the early stages of cooperation (Vlaar, Van den Bosch and Volberda, 2006). In those early stages, inter-organizational relationships are frequently characterized by relatively high levels of ambiguity and uncertainty (Carson, Madhok and Wu, 2006). This leads participants in such relationships to develop distinct interpretations and understandings of the same phenomena (Vaara, 2003; Porac, Ventresca and Mishina, 2002) and it increases the likelihood that misinterpretations and misunderstandings occur (Shankarmahesh, Ford and LaTour, 2004). More particularly, it confronts them with difficulties in understanding their partners, the relationships in which they are engaged and the contexts in which these are embedded. It is therefore extremely important to focus in those early stages on sensemaking (Vlaar, Van den Bosch and Volberda, 2006).

Secondly, the role of trust in collaborative relationships is of fundamental importance (Economist Intelligence Unit, 2008; Johnston et al., 2004; Vangen and Huxham, 2003; Dirks and Ferrin, 2001; Smith, Carroll and Ashford, 1995). At a general level, trust is the willingness to accept vulnerability based on positive expectations about another's intentions or behaviors (Rousseau et al., 1998; Mayer, Davis and Schoorman, 1995). But it can also be defined as an individual's confidence in the good will of the others in a given group and belief that the others will make efforts consistent with the group's goals (Ring and Van de Ven, 1994). Subdivision of work implies that actors must exchange information and rely on others to accomplish goals without having complete control over, or being able to fully monitor, others' behaviors. Trust has several aspects, such as competences, intentions, and motives (Nooteboom, 2004; McEvily, Perrone and Zaheer, 2003). In addition, one's trust in an individual may be based on one's trust in the organization he belongs to. Trust in an organization can be based on trust in the people in it, it can be affected by corporate communication, but ultimately the proof lies in the performance of its people (Nooteboom, 2004). One cannot buy and install trust, it has to be built up in the relation, in 'process-based' trust. One can only create conditions for it to develop (Nooteboom, 2004). In healthcare, trust related issues between different professionals, such as generalists and specialists, go back the educational environment (Beaulieu et al., 2009). Although trust exists at the individual and at the inter-organizational level (Vangen and Huxham, 2003; Zaheer, McEvily and Perrone, 1998), it is discussed here at the individual level since it are individuals as members of an organization, rather than organizations themselves, that trust.

Thirdly, a barrier to collaboration is differences in power and status (Hardy and Phillips, 1998). More equitable and less hierarchical models of inter-professional collaboration will

be more successful (Richards et al., 2000). In healthcare, especially doctors seem to be hard to engage in a collaborative process due to their specific powers, status, professional socialization, and decision making responsibility; they often claim to have exclusive authority over particular knowledge and skills (Whitehead, 2007). This might be caused by the medical education they receive and the socialization process students go through when becoming a doctor (Whitehead, 2007).

Fourthly, collaboration requires staff time and attention, a resource that is often in short supply (Scott and Hofmeyer, 2007). This results to increasing workloads for staff and potentially to burnout and exhaustion (Weinberg, 2003). In healthcare, clinical settings can be frenetic and chaotic and doctors are often extremely busy. As a result, collaboration takes place around the doctor's schedule, hereby reinforcing the doctor's centrality and predominance (Whitehead, 2007).

Other aspects on the individual level that are mentioned in the literature are: collaboration skills (Beaulieu et al., 2009; Vyt, 2008; Scott and Hofmeyer, 2007), collective, inter-professional learning (Braithwaite et al., 2007; Van Wijngaarden, de Bont and Huijsman, 2006), regular personal informal contact (Vyt, 2008; Tsai, 2002), and friendship (Ingram and Roberts, 2000).

Organizational Level

Several factors on the organizational level play a role in inter-organizational collaboration. Firstly, there are differences between organizations that result in problems of understanding (Vlaar, Van den Bosch and Volberda, 2006). Organizations have different structures, cultures, functional capabilities (Barkema and Vermeulen 1997; Doz 1996), cognitive frames (Nooteboom 1992), terminologies (Kaghan and Lounsbury 2006), and management styles and philosophies (Lane and Lubatkin 1998). In healthcare, differences in status are an obstacle to collaboration; an acute hospital has a higher status than a skilled nursing facility, which has a higher status than home care (Gittell and Weiss, 2004).

Secondly, organizations can use several coordination mechanisms to sustain intra- and inter-organizational coordination, as is summarized by Gitell and Weiss (2004): cross-functional/organizational routines or protocols, information systems, cross-functional boundary spanners or liaisons, cross-functional meetings, shared incentives, shared performance measures, shared supervision, shared selection systems, shared incentive systems and shared training and accounting systems. For healthcare specifically, Gitell and Weiss (2004) found that routines, information systems, meetings and boundary spanners are the most important coordination mechanisms, both on the micro and the macro level. In addition, they state that internal collaboration has an effect on external collaboration, and vice versa. Therefore they propose that the internal and the external coordination

mechanisms have to be aligned in order to come to the best results regarding intra- and inter-organizational coordination.

Thirdly, team structure and team processes have an effect on inter-organizational collaboration in healthcare. Regarding team structure, the following are important indicators of successful teamworking (Xyrichis and Lowton, 2008; Vyt, 2008): team premises (being close by), team size (smaller teams correlate to higher effectiveness), team composition (higher occupational diversity correlates to overall effectiveness and innovation), leadership (clarity of leadership), the availability of organizational support, and stability of the team (how long people are working together). Regarding team processes, the following appear to foster effective teamworking (Xyrichis and Lowton, 2008; Vyt, 2008): setting clear goals and objectives for the team (thus no blurring and misunderstanding of professionals' roles and responsibilities), ensuring regular team meetings (results in positive interpersonal relations and enhanced communication), a common framework and working tools that stimulate sharing knowledge, and audit. In addition it is found that mutual respect, collective code of ethics, shared complementary responsibility, and knowledge of and respect for team members competences, roles and contributions enhance team performance (Vyt, 2008). Also, dimensions of proximity are relevant to inter-organizational collaboration: geographical, organizational and technological proximity (Petrakou, 2009; Knoben and Oerlemans, 2006).

Systems Level

On a systems level, a clear proactive integrated care policy by national government as well as regional and local authorities matters (Wadmann, Strandberg-Larsen and Vrangbæk, 2009; Mur-Veeman, Van Raak and Paulus, 2008). However, even with a proactive integrated care policy, an abundance of obstacles remains at various levels: dividing lines between sectors, inter-organizational and inter-professional boundaries, and a lack of communication and coordination (Mur-Veeman, Van Raak and Paulus, 2008), as described above. In addition, a country's culture, as reflected in the norms and values of the actors, form a potential explanation for the state of affairs concerning integrated care, and for the interactions between the actors and the choices they make (Mur-Veeman, Van Raak and Paulus, 2008).

One aspect of national policy is the payment system. For example, in the Netherlands they recently have introduced an integrated payment system to stimulate integrating care across organizations. However, an integrated payment system alone is not sufficient, other important conditions for success are: complete care protocols describing both general (e.g. smoking cessation, physical activity) and disease-specific chronic care modules, coverage of all components of a disease management program by basic healthcare insurance, adequate information systems that facilitate communication between caregivers, explicit

links between the quality and the price of a disease management program, expansion of the amount of specialized care included in the chain-DTC, inclusion of a multi-morbidity factor in the risk equalization formula of insurers, and thorough economic evaluation of disease management program (Tsiachristas et al., 2011).

Collaboration between healthcare organizations and integrated care require integrated supervision. A country's healthcare inspectorate may help healthcare providers implement more fully integrated care by using effective supervision methods such as advice and encouragement. Publishing inspection results may also contribute to a speedier implementation process (Ketelaars, 2011). In addition, there have to be clear guidelines on who is responsible for self-management and self-treatment by patients, when multiple organizations are involved (Petrakou, 2009).

2.7 Summary and Concluding Remarks

As is described in the first chapter, one root cause for problems in healthcare is the design of the services provided. This research focuses on *care-cure* conditions, which have in common that patients have a general need for *care* and in case of an episode; they have a need for *cure*. Examples are chronic conditions, mental health disorders such as depression, and pregnancy.

Traditionally, for these *care-cure* conditions, healthcare is delivered according to the "acute care" model. It is specialist care, focused on *cure*, on medical intervention, often delivered in hospitals. However, in the last decade, there is growing awareness of the value of *care*, of the prevention and the psychosocial aspects of these *care-cure* conditions and as a result new models of care are being developed in order to meet the *care* needs of patients also. Nowadays, different inter-organizational designs can be found, varying from organizations that are able to meet both the *care* and the *cure* needs, to organizations that are specialized in meeting only a specific need of a specific type of patients. The problems that are experienced in the different systems are problems of fragmentation and coordination, and problems of knowledge and experience that professionals have with regard to specific conditions. The literature is ambiguous regarding what inter-organizational design would work best. Solutions are found in moving towards integrated care, and on delivering *care* in primary care instead of in secondary care.

A closer look at the solutions, teaches us that what the various solutions regarding integrated care have in common is that they all focus on improving collaboration between organizations and between professionals. It therefore seems that the level of collaboration between organizations is important for the effect on people's health and wellbeing.

Collaboration in this research is marked by knowledge contribution, equal distribution of power, and a focus on achieving best outcomes without regard to discipline, hierarchy, or even organizational boundaries (Kinnaman and Bleich, 2004). This research focuses on horizontal collaboration on a personal/role and macro level. It concerns collaboration in the healthcare sector between professionals/roles from different organizations.

Collaboration has a variety of drivers and barriers. Firstly, on the individual level the following are important aspects: the differences between professionals, trust, power, status, work pressure, collaboration skills, and regular personal contact. Secondly, on the organizational level the following are mentioned in the literature: cultural differences between organizations and coordination mechanisms such as cross-functional meetings, shared incentives, shared goals, shared supervision, and shared information systems. In addition, team structure and team processes are important, such as team size, team composition, leadership, mutual respect, a shared code of ethics. Finally, on the national level, a proactive policy by government and an integrated payment system can stimulate collaboration across organizations.

Thus, the literature is ambiguous regarding what inter-organizational design would work best, whereas there is consensus on the major importance of inter-organizational collaboration in improving healthcare. This research focuses on the intersection of inter-organizational design, inter-organizational collaboration, and patients' flow, health and wellbeing.

Chapter 3.

Research Design and Methods

3.1 Introduction

This research aims to contribute to the development of theory regarding inter-organizational designs in the healthcare sector. The research question is 'what inter-organizational design would work best for *care-cure* conditions, so that patients' needs are met, and that problems due to fragmentation are overcome?'

Chapter 2 showed that the literature is ambiguous regarding what inter-organizational design would work best; different inter-organizational designs can be found in practice, varying from organizations that are able to meet both the *care* and the *cure* needs, to organizations that are specialized in meeting only a specific need of a specific type of patients. The problems that are experienced in the different systems are problems of fragmentation and coordination and problems of knowledge and experience that professionals have with regard to specific conditions. Solutions are found in moving towards integrated care. There is consensus on the major importance of inter-organizational collaboration in improving healthcare. As such, this research focuses on the intersection of inter-organizational design, inter-organizational collaboration, and patients' flow, health and wellbeing.

This research applies a mixed method approach (Section 3.2) and aims to contribute to theory building through case study research and through simulation, as Eisenhardt (1989) and Davis, Eisenhardt and Bingham (2007) have described (see Section 3.3). The case setting is Dutch perinatal care (see Section 3.4). The simulation model is based on the case study and the simulation method used is system dynamics (see Section 3.7).

In order to answer the overall research question for Dutch perinatal care, one has to understand the problem of the current system (what-question) and understand what causes the problem (why-question) before one can improve it (how-question). Each of these three questions (what-why-how) is dealt with in its own phase, each with its own research method. The phases slide into each other through the detailed questions that are answered. Thus question 1b. is a forerunner for phase 2 and question 2c. is a forerunner for phase 3.

Phase 1: What?

The first phase focuses on understanding Dutch perinatal care and on understanding its problems. Dutch perinatal care is organized in line with principles of the focused factory concept (more on the focused factory concept in Section 2.3): midwifery practices are responsible for low-risk pregnancies and obstetric departments in hospitals are responsible for high-risk pregnancies (see Chapter 4). Is this inter-organizational design concept working well for Dutch perinatal care? And if it is not, how come? As such, the research questions are as follows:

RQ 1.a. *Is the design of Dutch perinatal care working well?*
RQ 1.b. *If it is not working well, why is that?*

This phase starts with an extensive description of Dutch perinatal care, its structure, its performance, its flaws and their root causes, which will be discussed in Chapter 4. Thereafter, this research will dig some deeper into one of the root causes: the current inter-organizational design. From an operations strategy perspective, in order to achieve great performance, there should be a fit between how a system is organized and how it operates. With the help of archival data analysis regarding the flow of pregnant women between a midwifery practice and a hospital in the region of Tilburg, insight will be gained in whether or not Dutch perinatal care is operating according to its design. The methods will be described in Section 3.5 and the results are presented in Chapter 5.

Phase 2: Why?

The second phase focuses on why Dutch perinatal care is not operating according to its design and why this situation persists. In searching for why it is going wrong, this research focuses on inter-organizational collaboration, as seems to be a key factor according to the literature review. This second phase should not only provide us with insight into why the design of Dutch perinatal care is not working well (behavior of the professionals), but also with some preliminary guidelines on how to improve perinatal care. The research questions are as follows:

RQ 2.a. *What is the status quo of inter-organizational collaboration in Dutch perinatal care?*
RQ 2.b. *What are the inter-organizational dynamics in Dutch perinatal care?*
RQ 2.c. *Are there preliminary guidelines on how to improve Dutch perinatal care?*

These research questions are being studied by clinical research, which is often placed in the broader context of action research, in which one tries to understand a system by trying to change it. In addition, the Renga approach is applied. The Renga approach allows one to gain insight into people's mental models, and as such in the dynamics of inter-organizational collaboration. The methods applied here are described in Section 3.6 and the results are described in Chapter 6.

Phase 3: How?

The third research question follows up on how to improve perinatal care; it focuses on what inter-organizational design would work best and on demonstrating why it might or might not work. The research question therefore is:

RQ 3. *What inter-organizational design would work best for Dutch perinatal care?*

Currently, different solutions are being implemented in practice. With the help of a system dynamics model, these improvements are tested. The method chosen is described in Section 3.7 and the results are presented in Chapter 7.

Phase 4: Developing theory
The last phase brings together the insights from the other three phases. This last phase links back to the research aim. Contribution to theory development is done by case study research (Eisenhardt, 1989) and by simulation (Davis, Eisenhardt and Bingham, 2007), in particular by system dynamics simulation (Schwaninger and Grösser, 2008; Sterman, 2000).

3.2 Mixed Methods

This research applies a mixed methods (or multiple research methods) approach. Mixed methods research combines elements of qualitative and quantitative research approaches (e.g. use of qualitative and quantitative viewpoints, data collection, analysis, inference techniques) for the broad purposes of breadth and depth of understanding and corroboration (Johnson et al., 2007). The use of quantitative and qualitative approaches in combination may provide a better understanding of research problems and complex phenomena than either approach alone, incorporating the strengths of both methodologies and reducing some of the problems associated with singular methods (Creswell and Clark, 2007).

Although the number of mixed method studies in (operations) management is still fairly low (Taylor and Taylor, 2009), there definitely is a movement towards acceptance of mixed methods: there is an increase in publications including academic journals, chapters within research texts and research texts themselves that are dedicated to mixed methods (Cheng, Choi and Zhao, 2012; Singhal and Singhal, 2012a; Cameron and Molina-Azorin, 2011). For management research, there is benefit in combining the complementary strengths of quantitative and qualitative approaches, because management research asks a large variety of questions, draws on numerous theoretical paradigms from a range of disciplines, and is characterized by investigations involving multiple levels of analysis (Currall and Towler, 2003). It is believed that mixed method research will become increasingly used by business and management researchers, especially those continually trying to innovate, add value and gain greater insights into increasingly complex business and management phenomena and discipline-based inquiry (Cameron and Molina-Azorin, 2011; Taylor and Taylor, 2009).

Mixed method research might be used when complementary data are sought, either qualitative data to enhance understanding of quantitative findings, or quantitative data to help generalize or test qualitative insights; when different methods are appropriate for

different elements of the project, with each contributing to an overall picture; or when data are sought from multiple independent sources, to offset or counteract biases from each method, in order to confirm, validate or corroborate the results and conclusions of the study. Mixed methods are typically employed in applied settings where it is necessary to draw on multiple data sources to understand complex phenomena, and where there is little opportunity for experimentation. The majority of those using mixed methods have consequently adopted a pragmatic position, looking for 'what works' in any particular situation (Tashakkori and Teddlie, 2003).

As Johnson, Onwuegbuzie and Turner (2007) summarized in their paper, one of the advantages of multiple research methods is an increased validation of the results through triangulation (Webb, Campbell, Schwartz and Sechrest, 1966; Campbell and Fiske, 1959). In this research three types of triangulation can be discerned. Firstly, between-methods triangulation, which involves the use of both quantitative and qualitative approaches (Denzin, 1978). Secondly, sequential triangulation (three phases), which is utilized when the results of one approach are necessary for planning the next method (Morse, 1991). Thirdly, simultaneous triangulation (within the second phase), which represents the simultaneous use of qualitative and quantitative methods in which there is limited interaction between the two sources of data during the data collection stage, but the findings complement one another at the data interpretation stage (Morse, 1991).

3.3 Theory Development

The research described in this thesis can be characterized as theory building, rather than theory testing. Although this research does not aim to develop a complete theory on the subject, the study aims to contribute to theory building, to be part of the process that eventually leads to such a theory. Theory is built through a combination of case study research and simulation. These two approaches will be discussed in the Sections 3.3.1 and 3.3.2. Why and how the two approaches to theory building are combined in this research is presented in Section 3.3.3.

3.3.1 Theory Development through Case Study Research

Building theory from case studies is a research strategy that involves using one or more cases to create theoretical constructs, propositions and/or midrange theory from case-based, empirical evidence (Eisenhardt, 1989). It focuses on understanding the dynamics present in case settings. Case studies can involve either single or multiple cases and numerous levels of analysis, they typically combine data collection methods (qualitative and quantitative) and can be used to accomplish various aims: to provide description, test theory or generate theory (Eisenhardt, 1989).

Eisenhardt (1989) presents in her paper a roadmap for building theories from case study research, based on existing work on grounded theory building (e.g. Glacer and Strauss, 1967), the design of case study research and qualitative (Yin, 1981) and quantitative methods (Miles and Huberman, 1984). This roadmap consists of eight steps. First, one has to get started with a definition of the research question and possibly some a priori constructs. Second, cases have to be selected, not by random sampling, but by theoretical sampling. Third, one has to craft instruments and protocols. Here, multiple data collection methods are advised, both qualitative and quantitative. Fourth, the field has to be entered and data has to be collected. The fifth step, analyzing the data, often overlaps with the fourth. In the sixth step the literature is enfolded. The data are compared with both conflicting and similar literature. Lastly, one should reach closure. This process is an iterative one; it involves constant iteration backward and forward between steps. These steps are also presented in Figure 3-1 in Section 3.3.3.

Eisenhardt (1989) presents the following strengths of building theory through case study research. First, the likelihood of generating novel theory. Second, emergent theory is likely to be testable with constructs that can be readily measured and hypothesis that can be proven false. Third, the resultant theory is likable to be empirically valid. Also, she presents two weaknesses: the intensive use of empirical evidence can yield theory which is overly complex and building theory from cases may result in narrow and idiosyncratic theory.

Theory development through case study research might be applied in the following situations (Eisenhardt, 1989). First, when little is known about a phenomenon. Second, when current perspectives seem inadequate because they have little empirical substantiation, or because they conflict with each other or common sense. And third, when serendipitous findings in a theory testing study suggest the need for a new perspective.

Papers that build theory from cases are often regarded as the “most interesting” research. A major reason for the popularity and relevance of theory building from case studies is that it is one of the best (if not the best) of the bridges from rich qualitative evidence to mainstream deductive research (Eisenhardt and Graebner, 2007).

3.3.2 Theory Development through Simulation

Davis, Eisenhardt and Bingham (2007) have developed a roadmap that describes theory development through simulation. Simulation is defined as a method for using computer software to model the operation of “real-world” processes, systems, or events. Simulation enables the elaboration of rough, basic (simple) theory. Simple theory is undeveloped theory that has only a few constructs and related propositions with modest empirical or analytic grounding. The propositions are in all likelihood correct but are currently limited by weak conceptualization of constructs. There are few propositions linking the constructs

together, and there is rough underlying theoretical logic (Davis, Eisenhardt and Bingham, 2007).

According to Davis, Eisenhardt and Bingham (2007), simulation is especially useful in the "sweet spot" between theory-creating research using methods as inductive multiple case studies and formal modeling, and theory-testing research using multi-variate, statistical analysis. In addition, simulation is especially useful for theory development when the focal phenomena involve multiple and interacting processes, time delays, or other nonlinear effects such as feedback loops and thresholds. Simulation is particularly useful when the theoretical focus is longitudinal, nonlinear, or processual, or when empirical data are challenging to obtain. Simulation is also particularly effective for theory development when the research question involves a fundamental tension or trade-off. The tension may be temporal, such as short- versus long-run implications; structural, such as too much structure versus too little; or spatial, such as near versus far away. These tensions often result in nonlinear relationships, such as tipping point transitions and steep thresholds.

Davis, Eisenhardt and Bingham (2007) provide three important strengths of developing theory with simulation. Firstly, the computational rigor of simulation forces precise specification of constructs, assumptions, theoretical logic and typically bounds the scope of the theory and so clarifies boundary conditions. Secondly, simulation can provide superior insight into complex theoretical relationships among constructs, especially when challenging empirical data limitations exist. Finally, simulation creates a computational laboratory in which researchers can systematically experiment (e.g., unpack constructs, relax assumptions, vary construct values, add new features) in a controlled setting to produce new theoretical insights. This experimentation is particularly valuable when the theory seeks to explain longitudinal and processual phenomena that are challenging to study using empirical methods because of their time and data demands, as is often the case with organizational and strategic processes.

Theory development through simulation goes through the following steps (Davis, Eisenhardt and Bingham, 2007). One starts with an intriguing research question. Next, a simple theory should be developed. The choice for a simulation method depends on the fit of the research question, assumptions, and the theoretical logic of the simple theory with those of the simulation approach. This is followed by a computational representation of the theory, involving operationalizing the theoretical constructs, building the algorithms that mirror the theoretical logic of the focal theory, and specifying assumptions that bound the theory and results. This computational representation has to be verified, which can be done in several ways: comparing simulation results with the (implicit or explicit) propositions of the simple theory, and/or doing robustness checks (sensitivity analysis). The next step is experimentation across a wide range of conditions, simply by changing the software code.

Ideally, the model is validated with real data. This roadmap for theory development through simulation is presented in Figure 3-1 in section 3.3.3.

3.3.3 Combining Theory Development through Case Study Research and Simulation

This research combines the two methods for theory development as described above: through case study research and through simulation. Developing theory through case study research *and* simulation builds a stronger case because of the following. Firstly, the intensive use of empirical evidence in case study research can result in theory which is overly complex (Eisenhardt, 1998). The advantage of developing a simulation model is that it requires the modeler to focus on the main variables and relationships in a system, and to leave "unnecessary" details out of the model.

Secondly, a weakness of building theory through only case study is low construct and internal validity and weak specification of boundary conditions (Davis, Eisenhardt and Bingham, 2007; Eisenhardt, 1998). A strength of simulation research is construct validity – an accurate specification and measurement of constructs (Cook and Campbell, 1979). Simulation requires precise specification of constructs and their measures, and so avoids "noisy" measurement that affects construct validity in empirical research (Rosenthal and Rosenow, 1991). In addition, as required by its rigorous, step-by-step logic, simulation involves precise specification of units of analysis and intervening constructs that are often poorly conceptualized and unmeasured in empirical research (Davis, Eisenhardt and Bingham, 2007).

Thirdly, a simulation model enables experimentation. Simulation creates a computational laboratory in which researchers can systematically experiment (unpack constructs, relax assumptions, vary construct values, add new features) in a controlled setting to produce new theoretical insights. Such experimentation is usually challenging in empirical research, particularly after the data are collected (Davis, Eisenhardt, Bingham, 2007).

The two approaches, theory building through case study research and theory building through simulation, are combined in this research. In the beginning the activities conducted correspond to the roadmap for theory building through case study, near the end, the activities conducted correspond more to the roadmap for theory building through simulation. Figure 3-1 shows how the steps taken in this research and the methods used fit with both approaches of theory building.

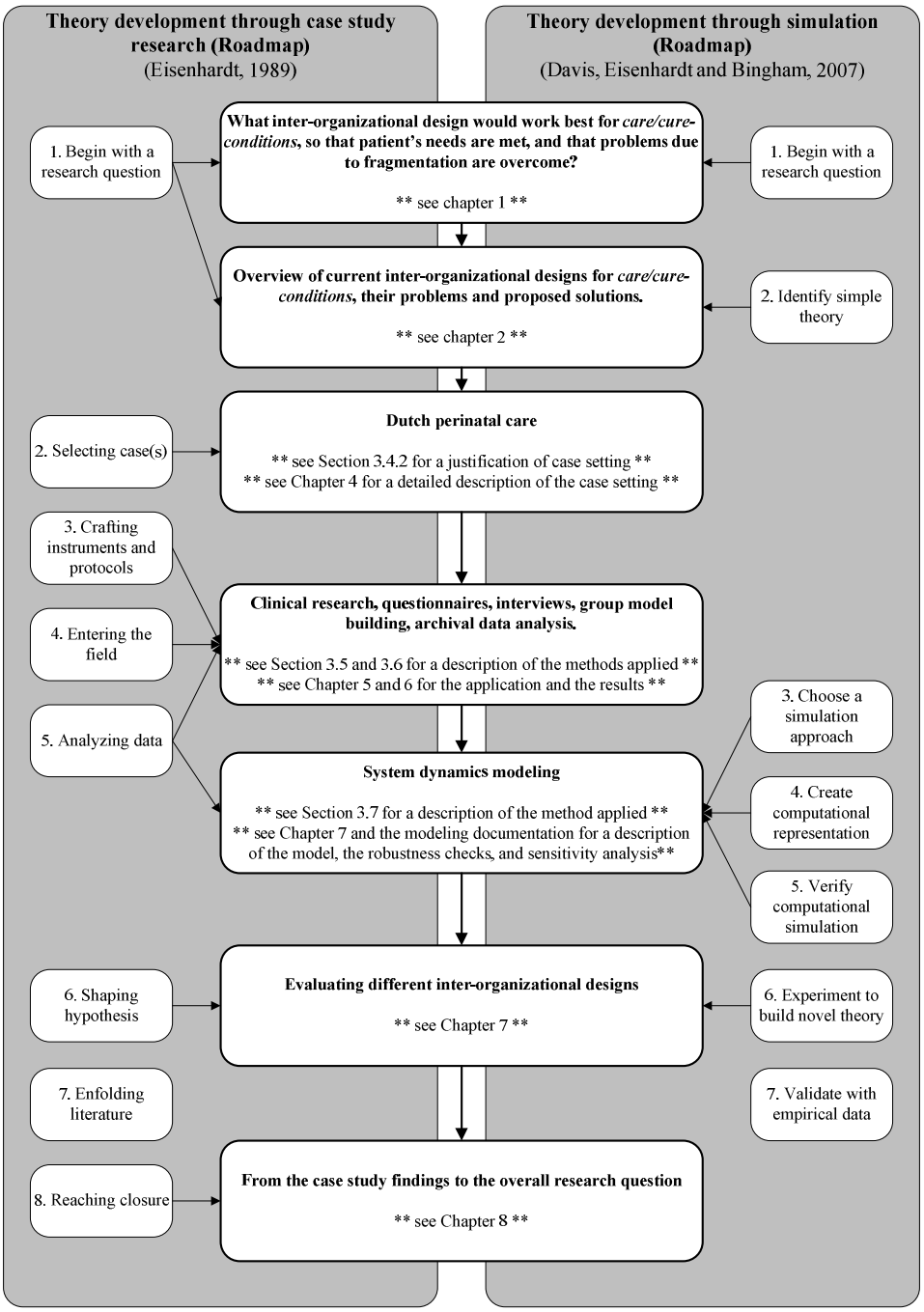

Figure 3-1 Theory development through case study research and simulation

3.4 Case Study Research

3.4.1 Case Study Research

Case study research is often applied in the field of operations and strategic management, organizational behavior and operations strategy (Voss, Tsikriktsis and Frohlich, 2002; Meredith, 1998). It is specifically suitable for addressing research questions regarding the 'how', 'what', and 'why' aspects of a phenomenon (Voss, Tsikriktsis and Frohlich, 2002; Meredith, 1998). Case study research is particularly appropriate for areas where research and theory are at their early, formative stages (Meredith, 1998), for early, exploratory investigations where the variables are still unknown and the phenomenon not at all understood. Case study is useful to understand complex social phenomena, in contemporary events but when relevant behaviors cannot be manipulated (Yin, 2003). It allows the phenomenon to be studied holistically (Yin, 2003), in its natural setting, which leads to a relatively full understanding of the nature and complexity (Meredith, 1998), for as it does take into account both the physical or 'hard' elements of organizations as well as the more human or 'soft' elements of the productive system (Voss, Tsikriktsis and Frohlich, 2002). Regardless of how cases are eventually used, research involving case data can usually get much closer to theoretical constructs and provide a much more persuasive argument about causal forces than broad empirical research can (Siggelkow, 2007).

Typically the prime source of data in case research is structured interviews, often backed up by unstructured interviews and interactions. Other sources of data can include personal observation, informal conversation, attendance of meetings and events, surveys administered within the organization, collection of objective data and review of archival sources (Voss, Tsikriktsis and Frohlich, 2002). The goal is to understand as fully as possible the phenomenon being studied through perceptual triangulation (Bonoma, 1985), the accumulation of multiple entities as supporting sources of evidence to assure that the facts being collected are indeed correct (Meredith, 1998).

3.4.2 Case Setting

Choosing which and how many cases to study are important methodological considerations (Yin, 2003; Stuart et al., 2002). This research consists of a single case study, which is obtained by theoretical sampling. A single case study increases the opportunities for a deeper observation, resulting in a richer description of the constructs being researched. This way, it becomes a much more coherent, credible, and memorable story (Siggelkow, 2007; Dyer and Wilkins, 2006). With a single case study one is more likely to gain insights into deeper social dynamics, in contrast to multiple case studies which are thinner and focus more on surface data (Dyer and Wilkins, 2006). In addition, single case studies are often chosen because they are unusually revelatory, extreme exemplars, or opportunities for unusual research access (Yin, 2003). Perinatal care in the Netherlands is chosen as the case

setting, and within this case setting, Tilburg is chosen as the site where an in-depth case study is conducted. As such, case data selection was conducted at two levels, making this a segmented case study design (Yin, 2003).

Perinatal Care in the Netherlands

This research focuses on a particular *care-cure* condition: being pregnant. Pregnant women do need both *care* and *cure* expertise; on the one hand they need general monitoring of the progress of the pregnancy and psychosocial care, and on the other hand, they need medical expertise, in case risks are developed in the pregnancy. Perinatal care in the Netherlands is chosen as the case setting for the following reasons.

Firstly, the Dutch perinatal care system is unique in the world. It is organized as a tiered system: midwifery practices, specialized in delivering *care*, are responsible for low-risk pregnancies and obstetric departments in hospitals, specialized in delivering *cure*, are responsible for high-risk pregnancies. In addition, whereas with many *care-cure* conditions only recently awareness is raised for the psychosocial aspects, for the *care* aspects, the Dutch perinatal care system is known for its midwifery model of care, which has a strong focus on *care*.

Secondly, the Dutch perinatal care system is a very pure system since only one inter-organizational design is applied. As such this inter-organizational design is developed to the fullest. It is a very stable system, which has been in place for many decades.

Thirdly, this research appears to have considerable practical relevance at this point in time both for Dutch perinatal care as well as for perinatal care systems elsewhere. In the last decade, more and more flaws of the Dutch perinatal care system have been coming up, such as high perinatal morbidity and mortality rates, high maternal morbidity and mortality rates and low satisfaction (see Chapter 4). At the same time, in the last decades, there continue to be movements in other Western countries to move more towards a system with stronger midwife involvement for low-risk pregnancies, and the Dutch system is often taken as an example (e.g. Goodman, 2007; Wagner, 2006; Gabay and Wolfe, 1995).

Perinatal Care in Tilburg

The site for an in-depth case study is that of perinatal care in Tilburg and its surrounding villages. As such this research is a single-case study. A single-case study is justified here because of the site being representative for Dutch perinatal care and because of the fact that it is a revelatory case (Yin, 2003). In addition, there are very few differences between the regional perinatal care systems in the Netherlands. Dutch perinatal care has been organized more or less the same throughout the Netherlands. The structure, the financial system, and the criteria to decide which risk category a pregnant woman belongs to, all these are

determined at a national level (see Chapter 4). In addition, this site was willing to let researchers in and share with them their professional lives and considerations.

Tilburg is the sixth city in the Netherlands by count of its inhabitants (in 2006 a little over 200.000 inhabitants) and is located in the south of the Netherlands. Tilburg has two hospitals: one in the north (NH) and one in the south (SH). Together with about 45 midwives, working in 12 different midwifery practices (MP), they provide perinatal care for Tilburg and its nearby villages. In 2005, the birth of about 4500 children was supported by this system. Each midwifery practice has a preference hospital to go to, mostly due to geographic reasons (see Figure 3-2). This results in two main regions: the south region and the north region. The obstetricians in the north hospital are employed by the hospital; the obstetricians in the south hospital form a partnership. Midwifery practices are formed of one or more midwives in partnership and one or more midwives who are employed by the partnership.

Even though many different disciplines are involved in delivering perinatal care to pregnant women, such as midwives, obstetricians, residents, general, obstetric and maternity nurses, pediatricians, ultra sound scan specialists and others, this research focuses on obstetricians and midwives, for as they are overall responsible for the care process.

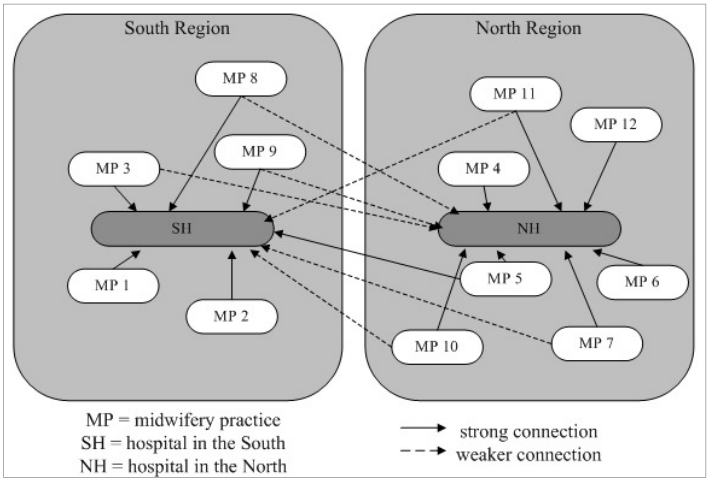

Figure 3-2 The two hospitals and twelve midwifery practice in Tilburg

3.5 Phase 1: What goes wrong?

The first phase of this research focuses on the inter-organizational design of Dutch perinatal care. It starts with an extensive description of Dutch perinatal care, its structure, its

performance, its flaws and their root causes, based on existing literature. This will be discussed in Chapter 4. Thereafter, this research investigates if the design concept of Dutch perinatal care is working well. One obvious approach is to look at performance in terms of medical and financial outcomes. However, that may be an oversimplification. To use an analogy: we all know that one should not use a hammer to drive in a screw, but if one hammers hard enough and the wood is sufficiently soft, then the screw will end up embedded in the wood nevertheless, albeit not very firmly. Thus, outcomes alone cannot fully determine applicability. It might therefore make more sense to look at the degree of fit between product characteristics and process characteristics to assess applicability, instead of looking at outcomes alone. For Dutch perinatal care, this will be discussed in Chapter 5.

3.5.1 The Notion of Fit

The notion of fit has a long history in the literature on organizational theory in general and that of operations management in particular (Venkatraman and Camillus, 1984). The synthesis of this literature is visualized in – what I call – the "integrated model of fit" (see Figure 3-3) where two environments are discerned: the internal and the external environment (Scott and Davis, 2007).

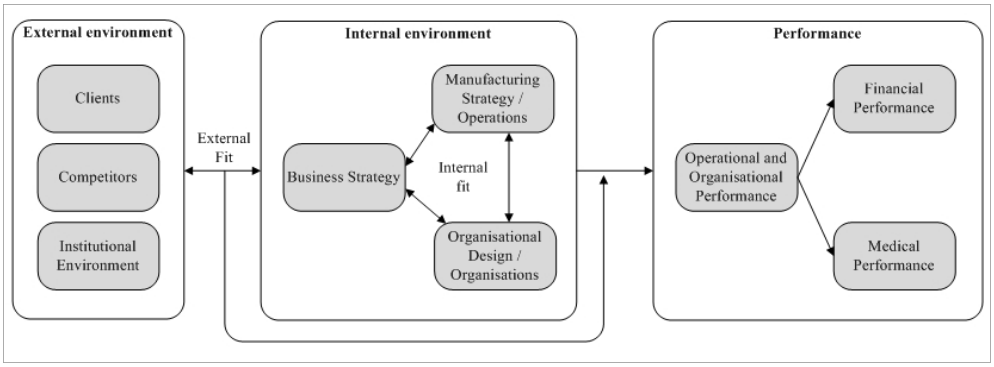

Figure 3-3 The integrated model of fit

Internal Environment

It is a well-established notion within organization theory and strategic management that there is a close correlation between the design of an organization, its business strategy, and its performance (Powell, 1992; Venkatraman and Camillus, 1984; Peters and Waterman, 1982; Pascale and Athos, 1981; Waterman, Peters and Philips, 1980). As such, this integrated model of fit states that superior operational performance requires a good internal fit (Smith and Reece, 1999; Gupta and Lonial, 1998; Swink and Way, 1994; Kotha and Orne, 1989; Venkatraman and Camillus, 1984).

Within the internal environment, three basic components are distinguished. The first component is business strategy. Although there are different frameworks to differentiate levels of strategy (Kotha and Orne, 1989; Beard and Dess, 1981), and although each framework uses slightly different definitions, it seems reasonable to use the term business strategy to refer to questions concerning what business the organization should compete in.

The second element of the internal environment is manufacturing strategy or operations strategy. Skinner states that the "manufacturing task" is the translation of "what it means to manufacturing" of the competitive strategy of the organization (Van Dierdonck and Brand, 1988; Skinner, 1974). This implies that better organizational/operational performance may be expected if the manufacturing strategy and the business strategy fit closely together (Gupta and Lonial, 1998; Swink and Way, 1995; Kotha and Orne, 1989). This does not only apply to manufacturing firms, but also to the service sector (Smith and Reece, 1999).

The third element is organizational design. Organization theory and strategic management theory both state that there is a close connection between the design of an organization, its business strategy, and its performance (Powell, 1992; Venkatraman and Camillus, 1984; Waterman, Peters and Philips, 1980), and that there should be congruence among the internal elements of organizational design, such as structure, style, staff, shared values, and skills (Peters and Waterman, 1982; Pascale and Athos, 1981).

Finally, there is the fit between the operations strategy and the organizational design. Skinner (1969) already stated that manufacturing has some important trade-off decisions to make in the field of labor and staffing, such as job specialization and supervision, and in the field of organization and management, such as group size of staff.

External Environment

Equally well established, and going back to such early writers on strategy as Ansoff (1965), is the notion that an organization's design and strategy (the selection of product mix and markets) should exhibit "an impedance match between the firm and the environment". As such, this integrated model of fit states that both a good internal fit and superior operational performance require a good external fit.

The external environment basically consists of all those significant elements outside the organization that influence its ability to survive and achieve ends (Scott and Davis, 2007), such as the industry, clients, competitors, governmental entities and professional groups (the latter two are grouped together in Figure 3-3 as institutional environment). In addition to congruence among elements of the internal organization, operations management, strategic management, and organization theory all state that congruence among the internal and the external environment is important (see for an overview of the literature

Venkatraman and Camillus (1984) and Powell (1992)). For example, Hill (1989) has argued that a strong link needs to exist between manufacturing tasks and customer needs.

Performance

Performance in the healthcare sector expresses itself in three ways: costs, medical performance and operational performance. The performance section of the model fits the performance measure taxonomy as described by Li and Benton (1996), which is a matrix with the following sides: internal versus external measures, and financial versus quality performance. In our model, costs represents external and internal financial performance, medical performance represents external quality, and operational performance represents internal quality. Interestingly, this split in three aspects of performance fits with classical healthcare research on measuring clinical quality. Here Donabedian (1969; 1966) has suggested three categories of quality: structure, process and outcomes. The operational performance construct relates to Donabedian's concept of structure, which refers not only to the relatively stable characteristics of the care providers, the tools and needed resources, but also to the physical and organizational setting in which the care is provided (Donabedian, 1980). Donabedian assumed that, given the proper settings and instrumentalities, good medical care would follow (Donabedian, 1969; 1966). Operational/organizational performance can be seen as the antecedent of medical and financial outcomes, and is therefore positioned between the internal environmental and the external performance measures such as costs and medical outcomes.

Manufacturing performance can be measured along several dimensions. In the operations management literature the following ones are often used: quality, time, costs and flexibility. Although there is much confusion over what these generic terms actually mean (Neely, Gregory and Platts, 1995), there is nevertheless a general consensus that performance measures should be derived from strategy (Neely et al., 1997).

3.5.2 Fit in Dutch Perinatal Care

To assess the applicability of the current inter-organizational design of Dutch perinatal care will mean to assess the degree of internal and external fit. The first kind addresses the question to what degree a perinatal care system that is organized on the basis of the two tiered structure will be internally consistent; the second kind of fit, to what extent internal processes will be aligned with the characteristics of the medical condition, i.e., pregnancy. This will be assessed by archival analysis in which flows of pregnant women will be analyzed. Data from pregnant women from a particular year from one hospital and one midwifery practice are collected. This included detailed data on individual consultations during pregnancy, and detailed data regarding every delivery. With the help of this archival data and additional interviews with stakeholders, insight will be gained in whether or not Dutch perinatal care is operating according to its design.

3.6 Phase 2: Why is it going wrong?

The second phase focuses on why Dutch perinatal care is not operating according to its design and why this situation persists. This second phase should not only provide us with why it is going wrong, but also with some preliminary guidelines on how to improve Dutch perinatal care. The approach taken is that of helping the selected site (Tilburg and its surrounding villages) improve perinatal care. Research is conducted from a clinical perspective and the Renga method will be used. It has to be noted that to what degree the client has been able to improve perinatal care because of our intervention is not subject of this research. This thesis only presents the insights regarding to the research questions, which could not have been gained without the intervention, which was aimed at improving perinatal care. The results of this second phase are presented in Chapter 6.

3.6.1 Clinical Research

Clinical research can be placed within the broader context of action research and organizational development. In clinical research (Coghlan, 2009; Schein, 1987), the clinician starts with an action research model of the organization, built on the assumption that the only way to understand an organization is to change it (Lewin, 1948), and that the only way to understanding, therefore, lies in deliberate intervention and the deciphering of the responses to the intervention (Schein, 1987). However, whereas clinical research is often presented as action research, there is a fundamental difference, as Schein describes in one of his papers (1995). This fundamental difference derives from a consideration of whose needs are ultimately driving the inquiry and helping process. In action research, as originally formulated by Lewin, the initial drive comes from the researchers, the client system involves in the researcher's agenda, even though the client system might ultimately be the beneficiary. The client did not initiate the process and it is not the client's needs that drive the process. In clinical research, researchers are hired to help, the research agenda comes from the needs of the client, clinical researchers are not only concerned with diagnosis but have a primary focus on treatment, and data gathering is driven by the client's needs (Coghlan, 2009; Schein, 1987). Clinical research provides the researcher with insights about what has "really happened" and how things "really work" around limited areas of organizational functioning, because people in the organization are motivated by their need to solve problems to tell what is really going on from their point of view (Schein, 1987). The word 'clinical' is deliberately chosen in order to highlight that some perceived pathology is involved and that the helper takes on the obligations that are associated with being in the helping profession, i.e. the interests and the welfare of the client must be protected at all times and all of the helper's actions are de facto interventions and must be evaluated as such before undertake (Schein, 1995).

The following clinical activities are often discerned: in-depth observation of crucial cases of learning and change, studying the effects of interventions, focusing on pathologies and post-mortems as a way of building a theory of health, focusing on puzzles and anomalies that are difficult to explain, building theory and empirical knowledge through developing concepts that capture the real dynamics of the organization, and focusing on the characteristic of systems and systemic dynamics (Coghlan, 2009; Schein, 1987).

Clinical research seeks to generate knowledge that is practical and useful for practitioners in particular settings. As such, clinical research does not aim to create universal knowledge. However, extrapolation from a local situation to more general situations is important. For the academic community, clinical researchers seek to extrapolate from the specific situation and offer considerations that might be useful for other organizations, perhaps like organizations or organizations undergoing similar types of change processes (Coghlan, 2009). This follow-up – analyzing the data, deciding what has been learned and how to present it – is typically not thought of as part of the clinical work (Schein, 1987).

Project Management

In 2006, an inquiry from obstetricians of the south hospital was made to the researchers regarding the improvement of perinatal care in the region of Tilburg. The intervention in the case site started with the Renga approach (see below), followed by the main researcher being a part-time project manager for 1 year. Aim was to align inter-organizational care processes and to improve the collaboration between the hospitals and midwifery practices. The researcher was independent; she did not have an interest in either the midwifery practices or the hospitals. The position was financed by the health insurance company CZ Zorgverzekeringen, which did not interfere with the process, nor with the desired outcomes.

3.6.2. Renga Approach

The Renga approach is developed by Akkermans to develop inter-organizational networks. As Akkermans presents in his paper (2001), the notion that networked firms are going to be the new dominant organizational form is increasingly taken for granted and it is unclear what the implications are for management of such networks. Three challenges are important: fostering trust and understanding, designing seamless collaborative workflows, and appreciating counter-intuitive behavior. The Renga approach – the Japanese poetry form Renga serves as a metaphor – facilitates network development by, on the one hand, creating favorable conditions for spontaneous bottom-up emergence of successful network relations and, on the other hand, developing – from a top-down perspective – workable business processes to embed those network relations in. This generic facilitation style is embedded in a project design that lends itself especially well to collaboration between groups from different organizational units. It has the following characteristics (Akkermans, 2001; 1995). Firstly, the Renga approach allows one to initially investigate a large number

of variables and their relations, and find out which of these appear to be the most significant, which is of importance when at the start of a project it is not known yet what all the relevant variables are, nor their precise relationships. Secondly, the Renga approach allows one to gain insight into people's mental models. Collaboration is formed by people's inner motivation, and therefore it is interesting to look for those inner motivations, to investigate people's inner worlds, and to gain insight into their mental models on collaboration. Thirdly, in order to gain insight into these mental models, close researcher participation is required, which is characteristic for the Renga approach. In addition, one of the main effects of the Renga approach is the creation of trust and mutual understanding among stakeholders, which is needed for network development.

The project phasing of the Renga approach is given in Figure 3-4. The Renga approach has three essential elements: group model building workshops, combining mental process maps, and system dynamics modeling and simulation. These elements link well to the challenges that network development faces, as described above.

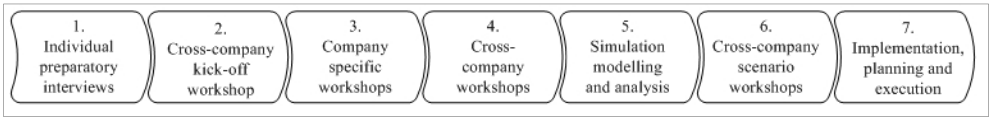

Figure 3-4 The Renga approach project phasing (Akkermans, 2001)

Group Model Building

People have mental images in their head of the world around them. Those mental images are a model on which all of their decisions are made. The mental models are fuzzy, are incomplete and change with time. Often people are not even aware of their mental models, the assumptions they make and the goals that they have (Forrester, 1971). With the help of group model building, these mental models of people can be made explicit.

Group model building assumes that people's mental models are limited by human information processing capabilities and that people have a strong tendency to think in terms of causal processes. As a result, people tend to think in simple causal chains rather than networks of related variables and it is rare for people to see more than one cause of a problem. Thus, when problems become more complex people will, by necessity, have a limited view of the problem (Vennix, 1996). Therefore, in a group model building project, one tries to elicit the hidden causal assumptions that people automatically hold, bring together different mental models of people involved, integrate these into a more complete representation of the problem, and define courses of action in which all team members will feel confident and to which they all feel committed. Thus group model building workshops (the company specific workshops and the cross-company workshops, see Figure 3-4) form an essential means for creating trust and mutual understanding between stakeholders in

network development. The design of these workshops is aimed at achieving an atmosphere of open and trusting communication, in which people can say what they really think without having to worry about adverse impacts of their words. Having a group facilitator with an independent and non-manipulative attitude in achieving such an atmosphere is of major importance.

Group model building is especially useful when it is not known what all the relevant variables are, nor what their precise relationships is. Group model building allows for a breadth first search strategy; initially investigate a large number of variables and relations, and find out which of these appear to be the most significant (Akkermans, 1995).

The goals of a group model building project can be described at three levels (Rouwette, Vennix and Van Mullekom, 2002; Vennix, Andersen and Richardson, 1997). Goals at the *individual level* are learning, mental model improvement, change in attitudes, change in behavior, positive reaction, commitment. At the *group level*, the goals are mental model alignment, consensus and commitment to a decision, increased quality of communication, creation of a shared language. At the *level of the organization*, system changes (doing things differently, and systems results (improvement of the problematic condition) are the main described goals.

Combining Mental Process Maps

Gaining insight into each other's mental maps is one of the key aspects of the Renga approach. Mental maps of the processes at stake are combined in three levels of abstraction (see Figure 3-4). First, there are individual preparatory interviews (individual level). Then, there are company-by-company process-mapping workshops (company level). After that, these company process maps are combined and discussed in one or more plenary workshops (network level). Each of these steps links with the others and is essential in assessing correctly the current work flows and in designing improved ones. The workshops utilize both a process view, using stocks-and-flow diagramming (Richmond, 1994), and a cause-and-effect perspective, using causal loop diagrams (Sterman, 2000). Both views are essential in achieving a thorough understanding of the underlying structure and the resulting dynamics of the network in operation.

Simulation

The primary goal of a system dynamics model is to enhance understanding of the system's behavior and to find robust policies to tackle strategic problems (Forrester, 1961; see for example also Sterman, 2000; Vennix, Akkermans and Rouwette, 1996). The group model building workshops as described before contribute to building a system dynamics model by eliciting model structure and engaging client teams directly in the process of model

conceptualization, formulation, analysis, and decision making (Andersen, Richardson and Vennix, 1997). System dynamics simulation is discussed in more detail in the next section.

3.7 Phase 3: How to improve?

This third phase in the case study focuses on evaluating alternative inter-organizational designs and on demonstrating why these inter-organizational designs might work and why they might not work. In addition, this third phase aims at contributing to the developing of theory regarding inter-organizational designs in healthcare. The results of this third phase are presented in Chapter 7 and 8.

3.7.1 System Dynamics

There are legions of systems thinkers, and they have their own special interpretations and contributions (Richardson, Wolstenholme and Morecroft, 1994). Sterman (2000, p. 4) states that "system dynamics is a method to enhance learning in complex systems. Just as an airline uses flight simulators to help pilots learn, system dynamics is, partly, a method for developing management flight simulators, often computer simulation models, to help us learn about dynamic complexity, understand the sources of policy resistance, and design more effective policies". All too often, well-intentioned efforts to solve pressing problems create unanticipated side effects. At the root of this phenomenon lies the narrow, event-oriented, reductionist worldview most people live by (Sterman, 2002). Most people believe cause and effect are closely related in time and space, while in complex dynamic systems cause and effect are often distant in time and space (Forrester, 1971). We have been trained to see the world as a series of events, to view our situation as the result of forces outside ourselves, forces largely unpredictable and uncontrollable. System dynamics helps us to expand the boundaries of our mental models, to lengthen the time horizon we consider so we can see the so-called unanticipated side effects, and the patterns of behavior created by the underlying feedback structure, not only the most recent events. As such we become aware of and take responsibility for the feedbacks created by our decisions (Sterman, 2002). The key aspect of system dynamics can be put in the following characterization: system dynamics is the use of informal maps and formal models with computer simulation to uncover and understand endogenous sources of system behavior (Richardson, 2011). The endogenous view is a crucial foundation of the field of system dynamics: in a system dynamics model, all behavior of a system is caused by endogenous sources (Richardson, 2011). As such, system dynamics is a structural theory of dynamic systems; it is based on the main hypothesis that the structure of systems is generally characterized by feedback loops, accumulation processes, and delays between cause and effect (Lane, 1999). It focuses on how causal relationships among constructs can influence the behavior of a

system. While each relationship in itself may be well-understood, their interactions in a system are often difficult to predict (Forrester, 1961).

System dynamics models consist of several building blocks, as is described well by Davis, Eisenhardt and Bingham (2007, p.486): "System dynamics typically models a system (e.g., organization) as a series of simple processes with circular causality (e.g., variable A influences variable B, which influences variable A). These processes have some common constructs and so intersect in a set of circular causal loops. These causal loops can be positive such that feedback is self-reinforcing and amplifying, or negative such that feedback is dampening (Sterman, 2000). The system typically includes stocks, acting as buffers (i.e., constructs with values that accumulate and dissipate over time, and so introduce time delays) and flows (i.e., constructs specifying temporal rates in the system)."

A system dynamics process consists of several steps (Figure 3-5) (Forrester, 1994). In the first step, the system must be described and a hypothesis must be generated for how the system is creating troubled behavior. Different sources of data are used: mental, written and numerical data (Forrester, 1980). One way of extracting mental data is group model building (see Section 3.6.2). Step 2 is the formalization of the simulation model. The system description is translated into the level and rate equations of a system dynamics model. Step 3 is the simulation of the model. One can achieve only a degree of confidence in the model that is a compromise between adequacy and costs of further improvement. Step 4 identifies policies for alternative testing. The alternatives may come from intuitive insights generated during the first three stages, from experience of the analyst, from proposals advanced by people in the operating system, or by an exhaustive automatic testing of parameter changes. Step 5 works towards consensus for implementation. The model will show how the system is causing the problems that are being encountered. To overcome both active and passive resistance requires sufficient duration and intensity of education and debate to reverse traditional practices. Step 6 implements the new policies. Evaluation of the policy changes comes after implementation. Evaluation will remain subjective since it can often take several years before new policies are being implemented and many other changes will have occurred in the system. The system dynamics model provides people with a better understanding of what is happening and more confidence in what they are doing.

System dynamics can provide theoretical insights that are not available from traditional operations management methods such as queuing theory or mathematical programming (Größler, Thun and Milling, 2008). There are several advantages of system dynamics, compared to traditional operations management methods (Größler, Thun and Milling, 2008). Firstly, system dynamics can handle problems that are characterized by the accumulation of resources, feedback, and delays. Secondly, system dynamics can handle

fuzzy and messy concepts like operations strategy and human behavior. And thirdly, system dynamics does not focus on discrete events or on behavior of individuals in the system, but it's emphasizes is on understanding the general dynamics of a situation and where it is not necessary or possible to specify the behavior of all individual agents and objects. Using system dynamics modeling for theory development and testing can help explain not only what is happening in a system but also why, how, and when the result is obtained and general insights into the design of the operations function are derived with the help of system dynamics analyses.

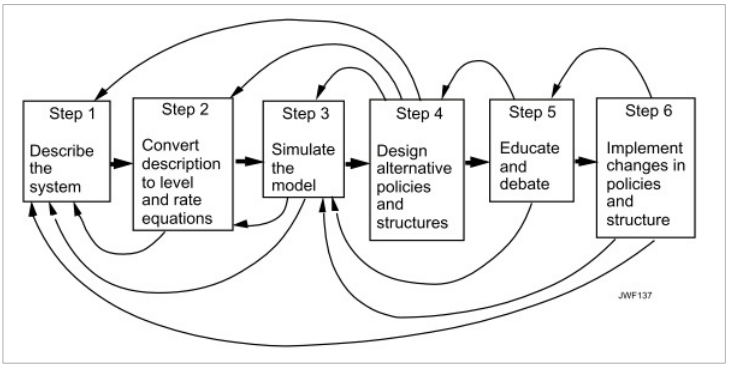

Figure 3-5 System dynamics steps from problem symptoms to improvement

3.8 Phase 4: Generalizability of the Findings

This research aims to contribute to theory development through a combination of case study research and simulation (see Chapter 8). As such, this research can be evaluated according to the following criteria: construct validity, internal validity, external validity, and reliability.

3.8.1 Construct Validity

Construct validity is concerned with establishing correct operational measures for the concepts being studied (Yin, 2003; Kidder and Judd, 1986). This research is a single case study and a limitation can be that sacrifices are made to the constructs it creates (Dyer and Wilkins, 2006). However, multiple sources are used to support construct validity (Yin, 2003). In the first phase, literature, archival data analysis and interviews with key stakeholders have been used, and in the second phase, questionnaires, interviews, group model building sessions, workshops and observations are used. Multiple researchers, midwives from midwifery practices and obstetricians from hospitals, have been involved in each of these activities, and the results are sent back to the participants to prevent

incomplete or incorrect information. The constructs found are compared with literature. In addition, theory is built not only on case study research but also on simulation, which results in higher construct validity (Davis, Eisenhardt and Bingham, 2007; Cook and Campbell, 1979) (see Section 3.2.3).

3.8.2 Internal Validity

Internal validity has to do with establishing a causal relationship, whereby certain conditions are shown to lead to other conditions, as distinguished from spurious relationships (Yin, 2003; Kidder and Judd, 1986). This is especially of importance for explanatory or causal studies. In this research, we assume relationships between the inter-organizational design of the perinatal care system, inter-organizational collaboration between midwifery practices and obstetric departments in hospitals, and performance. To uphold internal validity, in the second phase, we applied the Renga approach, which is especially used when the relevant variables and their relations are still unknown. This approach allows one to investigate a large number of variables and their relations by gaining insight into the mental models of the stakeholders involved (Akkermans, 2001; 1995). In addition, the empirical observations and findings from the second phase are compared with existing literature on collaboration before being operationalized in the simulation model. In the third phase, in which the simulation model is developed and used, verification of the computational representation is of importance to internal validity (Davis, Eisenhardt and Bingham, 2007). A variety of tests is applied to the simulation model to uncover flaws, such as robustness checks, extreme conditions tests, sensitivity analysis, etcetera (Sterman, 2000). These are described in Appendix F.

3.8.3 External Validity

External validity is related to establishing the domain to which a study's findings can be generalized beyond the immediate case studies (Yin, 2003; Kidder and Judd, 1986). Yin (2003) points out that generalizing from cases takes place according to analytical generalizations instead of statistical generalizations. This means that one concentrates on the expansion and generalization of theories rather than the enumeration of frequencies. In addition, the purpose of this research is to contribute to theory development, not to test it. And as such, theoretical sampling simply means that the case is selected because it is particularly suitable for illuminating and extending relationships and logic among constructs (Eisenhardt and Graebner, 2007).

Even though often a multiple case study design for theory building is recommended (Voss, Tsikriktsis and Frohlich, 2002; Eisenhardt, 1998), we applied a single case study design. A single case study has advantages. It increases the opportunities for a deeper observation, resulting in a richer description of the constructs being researched. As such, it becomes a much more coherent, credible, and memorable story (Dyer and Wilkins, 2006). With a

single case study one is more likely to gain insights into deeper social dynamics, in contrast to multiple case studies which are thinner and focus more on surface data (Dyer and Wilkins, 2006). Since the improvements in healthcare for *care-cure* conditions focus on collaboration between professionals, it makes sense to study the social dynamics in the field in detail.

Even so, the limitations of a single case study design are partly overcome since the generalization is not only based on the single case study: findings from the case study are combined with insights from the literature in a simulation model, on which theory is developed. In general, comparing the simulation results with empirical data strengthens external validity of the theory (Campbell and Stanley, 1966). However, there is some debate about the value of this validation. According to Davis, Eisenhardt and Bingham (2007) the value of empirical validation of the simulation model depends on the source that is the basis of the model: if the theory is primarily based on empirical evidence (e.g. field-based case studies and empirically grounded processes), then validation is less important because the theory already has some external validity.

3.8.4 Reliability

Reliability of a study demonstrates that the operations of a study can be repeated with the same results and has the goal of minimizing errors and biases in the research (Yin, 2003; Kidder and Judd, 1986). For this study, reliability would mean ensuring that, when following the same procedures for the same case, another researcher can obtain the same findings and results. Reliability is often achieved through documentation and tactics for avoiding researcher bias.

In the first phase, researcher bias is reduced by having both the main researcher and an obstetrician look at the data of pregnant women that are analyzed. In addition, the results are discussed with both obstetricians and midwives from the organizations involved. In the second phase, researcher bias is reduced by the fact that interviews, group model building sessions and workshops were attended by two researchers and by the fact that notes of the interviews, group model building sessions and workshops were send back to the participant for review.

Regarding documentation of data analysis, the main decisions made in merging data from different databases from different organizations are documented, and the design of the second phase follows the well-documented Renga approach closely. In addition, the structure of the model and the sensitivity analysis conducted are described in detail.

Still, with the measures as described above to increase reliability, this research is expected to have low reliability to some extent. The second phase of this case study is also an

intervention (Schein, 1987), conducted by the main researcher: actual improvements are being designed and implemented in order to improve perinatal care in Tilburg and its surrounding villages. As such, it is expected that a different researcher would not find the same results regarding the performance and the level of inter-organizational collaboration. However, dynamics regarding inter-organizational collaboration and the effect of collaboration on the care process are of a structural nature. Other research should be able to retrieve this same structure and thus develop the same system dynamics model. The structure is retrieved with the Renga approach, which is well documented in the literature (Akkermans, 2001; 1995) as well as in the documentation of this research.

Chapter 4.

Perinatal Care in the Netherlands

4.1 Introduction

This chapter, together with Chapter 5, focuses on the first phase of this research: understanding what is wrong with Dutch perinatal care. The chapter starts with a description of perinatal care, why it is important, what kind of inter-organizational designs can be found in practice, and what the needs are of pregnant women (Section 4.2). Thereafter, this chapter focuses on Dutch perinatal care. In Section 4.3 the structure of Dutch perinatal care is discussed in terms of the model of fit, as is discussed in Section 3.4, and it is argued that Dutch perinatal care is organized in line with principles of the focused factory concept. The performance is discussed in Section 4.4 and the root causes for malfunctioning are presented in Section 4.5. Section 4.6 presents the way forward.

4.2 Perinatal Care

4.2.1 Defining Perinatal Care

Different stages are defined for pregnancy, each with its own needs (Figure 4-1). In the pre-conception phase a woman tries to get pregnant. Sometimes extra care is needed, either to become pregnant (in vitro fertilization) or to reduce the risk at complications during pregnancy (for example by taking folium). The antenatal phase is characterized by the woman being pregnant. This phase is divided in a first, second and third trimester (respectively 0 - 14 weeks, 15 - 27 weeks, and 28 weeks - birth). Regular check-up visits are recommended, some accompanied with blood tests, ultrasound scans, prenatal screening and other medical tests. If complications occur, admission in the hospital might be necessary. The third phase is the phase during labor and delivery (intrapartum care). A delivery can be a normal, vaginal delivery, or, if complications occur, an instrumental delivery (such as forceps) or even a cesarean section. The final and fourth phase is the phase of caring for mother and baby after the delivery (postpartum or postnatal care).

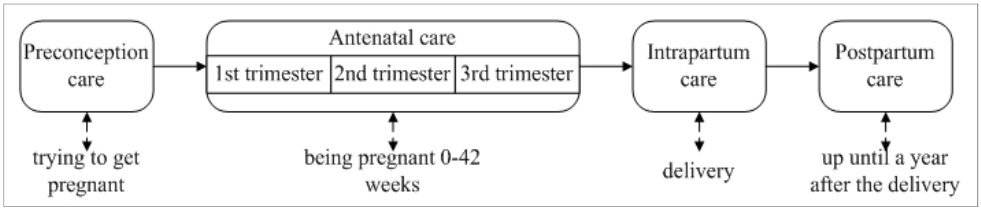

Figure 4-1 Phases of pregnancy

In general, obstetricians (and their residents) and/or midwives form the basis of the care process in the first three phases. When necessary, other professionals, such as general practitioners, pediatricians and nurses, will assist. In the first few weeks of the postpartum

care phase, obstetricians and/or midwives still play a major role, together with maternity nurses. Later, care is taken over by child welfare, child and family health nurses and/or health visitors.

The care process for women during the antenatal, intrapartum and postpartum phases is known by a variety of terms: midwifery care (WHO, 2013a; National Perinatal Association, 2008), obstetric care (WHO, 2013b), maternal care (WHO, 2013c), maternity care (Maternity Service Liaison Committees, 2013; Lowdermilk, Perry and Bobak, 1997) and perinatal care (American Academy of Pediatrics & American College of Obstetricians and Gynecologists, 2007; Rodriguez and Rivieres-Pigeon, 2007). Some of these descriptions have a slightly different focus. For example, midwifery care refers more to care delivered by midwives, obstetric care refers more to specialist, medical care, delivered by obstetricians, and maternity care refers more to care delivered by nurses and/or to the postpartum phase.

Since the Netherlands has a tiered system for perinatal care, the terms midwifery care and obstetric care are more often used than perinatal care. However, since this research concerns the care for pregnant women from the start up until giving birth, regardless of the organization that delivers the care, the more neutral term "perinatal care" is chosen. Whereas perinatal care has been referring to the care starting from 28th week of pregnancy to 7th day after delivery (American Academy of Pediatrics & American College of Obstetricians and Gynecologists, 1992, p. 262), nowadays it often refers to the whole spectrum of antenatal, intrapartum and postpartum care (American Academy of Pediatrics & American College of Obstetricians and Gynecologists, 2007, p. xii and p. 6; Rodriguez and Rivieres-Pigeon, 2007). In this research the term "perinatal care" will refer to antenatal and intrapartum care.

4.2.2 Importance of Perinatal Care

Being pregnant is a natural event, but it is not free of risks; the course of a pregnancy and delivery might have negative effects on the physical wellbeing of the mother, but also on the unborn child and on possible future children (e.g. Edlow, Srinivas and Elovitz, 2007). However, perinatal care is not only about the medical outcome; it is also about the experience itself. Childbirth often is one of the most profound experiences in a woman's lifetime and even a pregnancy which results in a healthy mother and a healthy baby can be experienced as traumatic (Rijnders et al., 2008).

Closely related to the physical and psychosocial wellbeing of mother and child(ren) are the costs of perinatal care. Especially in the United States, perinatal care is a major part of the healthcare system. Childbirth is the leading reason for hospitalization, six of the fifteen most commonly performed hospital procedures in the entire population are associated with

childbirth, and cesarean section is the most common operating room procedure in the country (Sakala and Corry, 2008). One has to take into account that the costs associated with perinatal care are not only associated with the pregnancy and delivery itself. Complications during pregnancy or delivery result in a demand for healthcare later in life (Barker, 2006; Conway and Kutinova, 2006).

For most adults pregnancy is the first event to come into contact with the healthcare system, having contact with the general practitioner for minor events excluded. As such, pregnancy provides an opportunity to guide families and families-to-be to health and social services.

4.2.3 Inter-Organizational Designs in Perinatal Care

Different ideologies in perinatal care exist (e.g. Van Teijlingen, 2005), with the two most extremes being the medical model (or illness-model) and the midwifery model (or wellness-model). In the medical model, pregnant women are primarily being cared for by obstetricians within a medical, hospitalized setting. The maternity care system in the United States adheres strongly to this model. Almost on the other side of the spectrum we find the midwifery model, stating that being pregnant and giving birth are healthy and natural events, physiological processes, involving no illness or disease. Perinatal care systems in Scandinavian countries, Canada and the Netherlands resemble this model. They have a larger midwifery population and/or more primary care facilities which take care of low-risk pregnancies (Malott et al., 2009).

In the perinatal care sector, the acknowledgement of the need for collaboration between healthcare providers has been stressed (De Leede et al., 2012; Downe, Finlayson and Fleming, 2010; Barimani and Hylander, 2008; Rodriguez and Rivieres-Pigeon, 2007), amongst other between obstetricians and other healthcare providers (FIGO, 2009), between obstetricians and midwives (Veer and Meijer, 1996), and between midwives and nurses (Kennedy and Lyndon, 2008). Multi-disciplinary team training is important to prevent the number of errors in perinatal care (Lonkhuizen, Dijkman, Van Roosmalen, Zeeman and Scherpbier, 2010) and research has been conducted concerning inter-professional educational programs for midwives and obstetricians (McConaughey and Howard, 2009; Saxell, Harris and Elarar, 2009; Fraser, Symonds and Cullen, 2005).

4.2.4 Needs of Pregnant Women

On an abstract level, the needs of pregnant women can be divided in psychosocial needs and physical needs. Psychosocial needs refer to the mental wellbeing, on how to live healthy during pregnancy, on the preparation on the delivery, on the preparation on motherhood and on how to take care of a newborn (*care*). The physical needs refer to the regular medical checkups and medical examinations regarding how well the baby and the mother are doing (*cure*).

Women value continuity, control and choice (Hundley et al., 1997). Regarding continuity, it's not necessarily that pregnant women value continuity of caregiver, instead, they value continuity of care (shared philosophy) (Freeman, 2006; Green, Renfrew and Curtis, 2000). Choice and control often refer to the delivery itself, in receiving all information and in being able to participate in the decisions that have to be made (Blix-Lindstrom, Christensson and Johansson, 2004). In addition, women's preferences included reasonable waits, unhurried visits, continuity, flexibility, comprehensive care, meeting with other pregnant women in groups, developing meaningful relationships with professionals, and becoming more active participants in care (Novick, 2009).

4.3 The Dutch Perinatal Care System

Perinatal care in the Netherlands is based on the midwifery model. Since the 17th century, the Netherlands have always had a large population of independent midwives assisting pregnant women throughout pregnancy and delivery. Midwives were responsible for low-risk pregnancies and deliveries, and when complications arose, they had to call a doctor (Christiaens, 2007; Houtzager and Lammes, 1996; Kloosterman, 1987). The position of these independent midwives was strengthened and formalized by government policy that became effective in the 1970s. Then, the healthcare system was restructured by strengthening echelons (first, second and third), each with a gatekeeper function (Structuurnota Gezondheidszorg, 1974). Patients have to use the most efficient echelon first (often primary care), and it has to be prevented that the patient receives care from a higher echelon when this was medically unnecessary. The intent of the policy makers was to have the bulk of the low-risk pregnant women served by one set of "factories", the midwifery practices, and the smaller group of high-risk pregnant women served by a different set of "factories", the hospitals. As such, one can argue that Dutch perinatal care is organized as a system of focused factories.

4.3.1 External Environment

Based on national obstetric guidelines (College voor Zorgverzekeringen, 2003), two groups are distinguished in the external environment: women with a low-risk pregnancy, and women with a high-risk pregnancy. These two groups are served by two completely different tiers, by very different professions, and by very different organizations. Low-risk pregnant women are cared for in primary care, by midwives working in independent midwifery practices. High-risk pregnant women are cared for in secondary and tertiary care, by obstetricians working in hospitals. The risk a pregnant women faces during her pregnancy or labor and delivery can change, resulting in a referral to another echelon. The original risk and referral criteria (List of Obstetric Indications, LOI) were set up in 1957

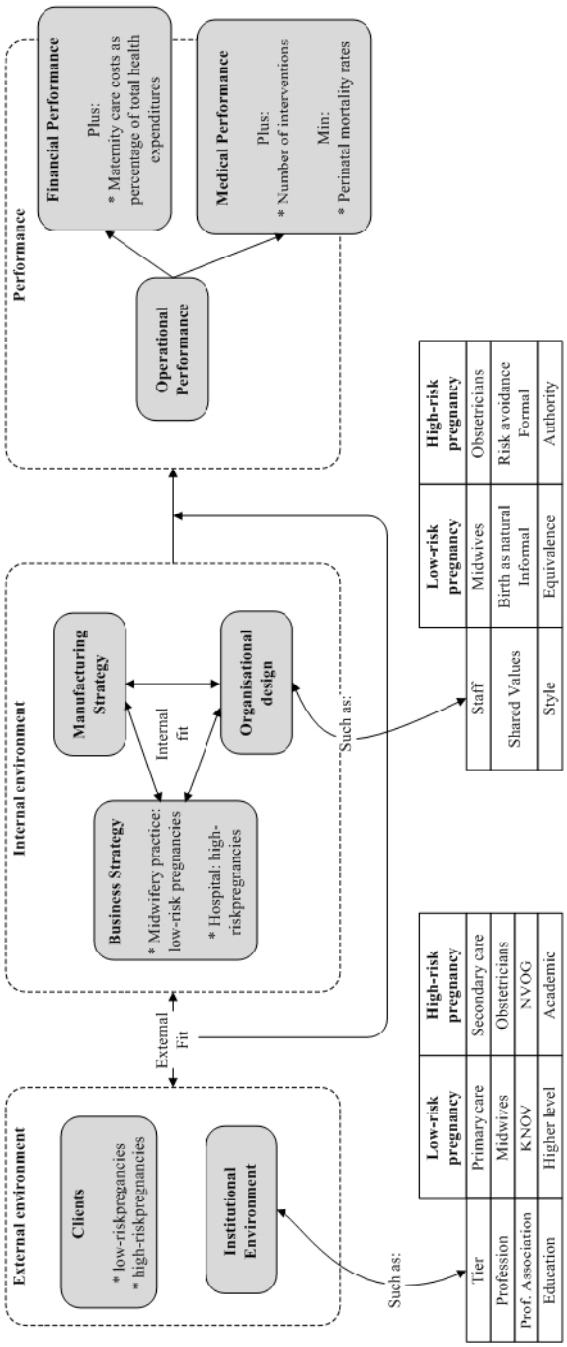

Figure 4-2 Dutch perinatal care

between medical advisors and insurance companies (Oppenheimer, 1993). Nowadays, the Royal Dutch Organization of Midwives (KNOV) and the Dutch Society of Obstetrics and Gynecology (NVOG) look after these criteria (College voor Zorgverzekeringen, 2003), which are updated when scientific knowledge progresses.

Policies and guidelines are developed primarily by different professional associations (the KNOV for midwives, and the NVOG for obstetricians), although discussed jointly if necessary, and managed by different sub-departments of the Department of Health (the department of primary care and the department of secondary care, respectively). In addition, both professionals (midwives and obstetricians) are educated at different levels and by different organizations, with virtually no attention given to the other profession. Furthermore, professional education courses are organized separately for each profession, even if the subject of the course is quite similar.

The financial structure and compensation for low-risk and high-risk pregnant women are different, each being taken care in different departments in health insurance companies. Insurance, which is obligatory for all inhabitants of the Netherlands, compensates all costs of perinatal care. Although low-risk pregnant women who want to deliver at the hospital have to pay a modest sum themselves.

Data regarding the perinatal care system is collected on a national level in the LVR1 (primary care) and the LVR2 (secondary care). The data are collected per midwifery practice or per hospital, data regarding individual pregnant women who attend multiple organizations is not put together. In addition, quality indicators for perinatal care have been developed in 2009, which will be implemented in the next years (Kooistra et al., 2008).

Pregnant Women

In 2007, the number of living births in the Netherlands was a little over 181.000 (CBS, 2012). The Netherlands Perinatal Registry has collected detailed information on a little over 173.000 births in 2007. Of those, 77.3% of the pregnant women started in primary care, with 32.1% of the pregnant women ending postpartum care also in primary care (Figure 4-3). 21.5% of the pregnant women gave birth at home, 67.1% in the hospital under supervision of an obstetrician, 11.3% in the hospital under the supervision of a midwife, and 0.1% gave birth elsewhere. In 6.6% of the pregnancies a cesarean section was done (Stichting Perinatale Registratie Nederland, 2009).

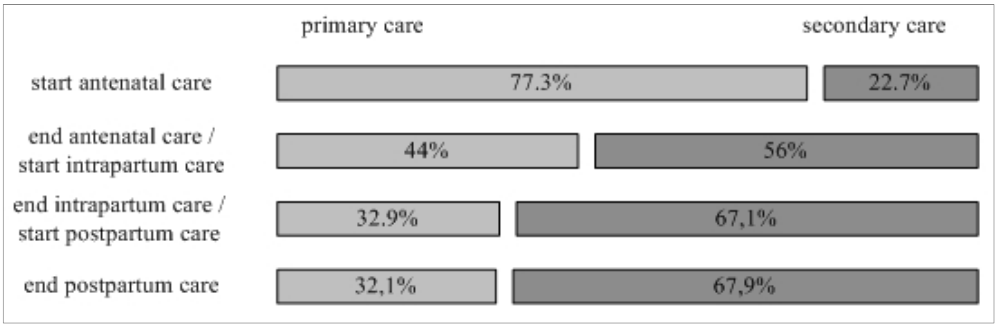

Figure 4-3 Pregnant women in primary and secondary care

Secondary Care: Hospitals and Obstetricians

There are about 675 obstetricians in the Netherlands (Van der Velden, Bennema-Broos and Hingstman, 2001). Obstetricians are working in hospitals. When a hospital is a teaching or an academic hospital, residents will be employed. To become an obstetrician one has to study medicine at an academic level (six years), and specialize into obstetrics/gynecology afterwards (six years). Residents are doing consultations and are present in the delivery rooms, they work more or less autonomous, and obstetricians only intervene when necessary. Obstetricians are first and foremost trained in risk reduction; in case of doubt, their first instinct is that it is strongly preferable to have events unfold in the hospital. All obstetricians are registered at the NVOG. The NVOG also develops policies and guidelines for their professional group. More and more, hospitals employ midwives (advanced midwives), who often have had extra training at a university (Wiegers and Hukkelhoven, 2010). In 2009, 23% of all midwives were working in a hospital (Hingstman and Kenens, 2009).

Collaboration between Primary and Secondary Care

Collaboration between midwives and obstetricians takes place at different levels (see Figure 4-4). At the national level, midwives are organized in the Royal Dutch Organization of Midwives (KNOV), and obstetricians are organized in the Dutch Society of Obstetrics and Gynecology (NVOG). Each of these professional associations looks after the interests of their profession and initiates quality improvement policies. In addition, they have shared responsibility over the national risk and referral criteria.

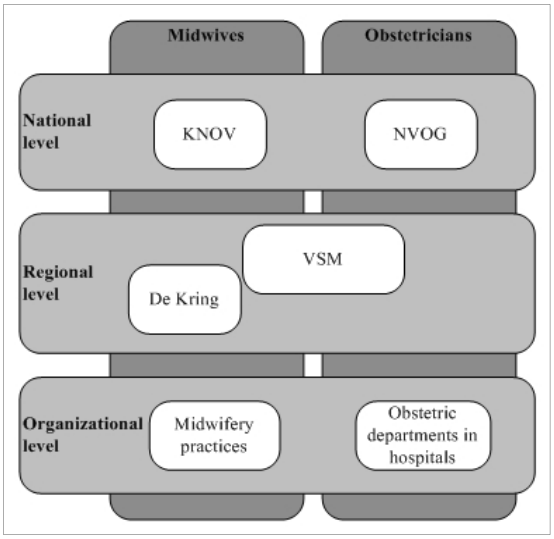

Figure 4-4 Inter-organizational collaboration

At a regional level, midwifery practices and obstetric departments of hospitals might be united. Different labels for these regional collaborative are used: Obstetric Co-operative Groups (Veer and Meijer, 1996), Verloskundige Samenwerkings Verbanden (VSV's) (Boesveld-Haitjema et al., 2008), or maternity care collaboratives (VSM). The objective of these groups or collaboratives is to define policy at a regional level, to discuss specific problems, and to find solutions together. Not every region has such a collaborative, and where they are in place they might not function properly. Professionals recognize the advantages of collaboration, but they also admit that feelings of competition stand in the way (Veer and Meijer, 1996). Moreover, midwifery practices are united in a regional association (De Kring). Their objectives are to look after their member's interests, to develop guidelines, to implement national policy at a regional level, and to initiate retraining courses.

At an organizational level, collaboration between a specific hospital and a specific midwifery practice might exist. For example, there might be agreements on using shared resources such as ultra-sound scans.

4.3.2 Internal Environment

Business Strategy

The business strategy for Dutch perinatal care is to have low-risk pregnant women being taken care of in primary care by midwives who are working in independent midwifery practices, and high-risk pregnant women being taken care of in secondary care by

obstetricians who are working in obstetric departments in hospitals. If a woman faces a risk during pregnancy or delivery, she is referred to the hospital for an obstetric consultation. If the risk is sufficiently serious, the woman is referred to the obstetrician definitively. These referrals are made on nationally established risk and referral criteria (College voor Zorgverzekeringen, 2003).

Operations in Primary Care

Regarding the operations aspects of the internal environment, during the antenatal phase, some 13 consultations are recommended for a low-risk pregnancy, of which 6 are considered medically necessary. The other 7 are required primarily from a psychosocial point of view (Heineman et al., 2004). In addition, basic physical examinations such as blood tests and echography are conducted. Women with a low-risk pregnancy give birth under the responsibility and supervision of a midwife. They have a choice in the place of birth: at home, in the hospital or in a birth centre. A birth centre provides a home-like environment, but is located near a hospital, which provides the women with faster access to the hospital in case of complications than when giving birth at home (De Graaf et al., 2003). The intended place of birth does not have to be the actual place of birth. For example, Figure 4-5 shows data of 2007: of all pregnant women who were going to deliver their first child, only about 35% delivered their child at the intended place of birth (De Neef, Hukkelhoven and Franx, 2009).

The Dutch have the highest percentage of home child deliveries in the western world. Whether a woman wants to deliver at home depends on personal characteristics, on the midwives attitudes towards home and hospital birth, and on whether there is a good co-operation with the hospital (Wiegers et al., 2000). Where in 1965 two-thirds of the children were born at home (Wiegers, Van Der Zee and Keirse, 1998a), this number has decreased to 23.9 percent in 2008 (CBS, 2011). Although giving birth at home has long been the ideal for most pregnant women with a low-risk pregnancy, it is expected that the percentage of women wanting to deliver in the hospital will increase in the next years (Pavlova et al., 2009), amongst others due to the availability of medical pain relief treatment in the hospital.

After the delivery, if medically allowed, the woman and her child(ren) stay home (or are going home from the hospital). They are taken care of by a maternity nurse, for 24 – 49 hours, spread out over 8 days (Landelijk indicatieprotocol kraamzorg, 2008). The maternity nurses are employed by specialized organizations. The maternity nurses especially have a caring task, helping the family out with daily activities. A midwife is responsible for the medical condition of mother and child. If complications arise, the midwife decides to refer them to the hospital.

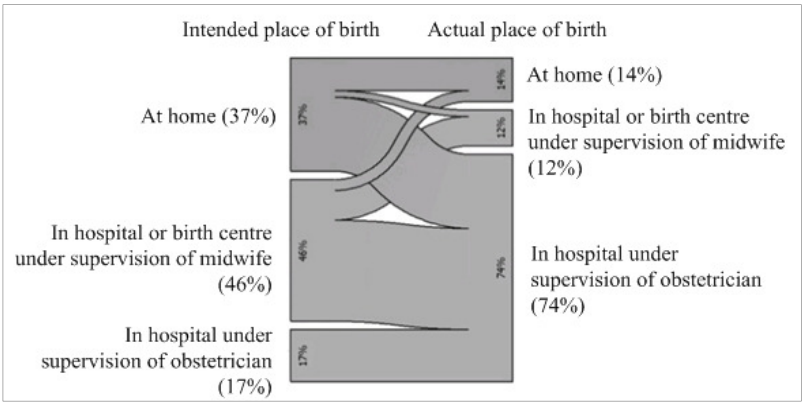

Figure 4-5 Intended and actual place of birth

Operations in Secondary Care

The required number of consultations for a high-risk pregnancy depends on the medical condition of the pregnant woman; it may also require admission to a hospital. In addition to the basic physical examinations, specialized examinations are conducted and other medical professions can be consulted (such as psychiatrists and oncologists). Delivery (natural or by cesarean section) takes place in the hospital, under the responsibility of an obstetrician, although the direct supervision can be executed by an advanced midwife or a resident.

In addition to low-risk and high-risk pregnancies, there exists a minor third category: pregnant women who have a higher health risk at delivery, but who are still most likely to experience a normal pregnancy. Obstetricians have agreed on having consultations done by midwives, up until week 36 of the pregnancy. From that point forward, the obstetrician becomes responsible again.

After the delivery, if medically allowed, the woman and her child(ren) are going home from the hospital, where primary care (maternity nurse and midwives) takes over the care process. As a follow up and evaluation, the new mother has one or more consultations in the hospital some time later.

Organization

Midwifery practices employ midwives, hospitals employ obstetricians and residents. Occasionally, Dutch hospitals may employ a small number of midwives. The cultural differences between midwives and obstetricians resemble the characteristics of their focus groups. Midwives strongly focus on having a pregnancy that is as natural as possible, without any unnecessary medicalization (Pel et al., 1995). If possible they wait to see if things get better. Obstetricians are first and foremost trained in risk reduction; in case of doubt, their first instinct is that it is strongly preferable to have events unfold in the hospital

(De Leede et al., 2012; Kennedy, Levi and Kane Low, 2006). Moreover, bedside manners between midwives are characterized by equivalence and informal relationships, while manners within the hospital setting are characterized by a more formal style and authoritarian leadership by the obstetrician.

4.4 Performance of Dutch Perinatal Care

4.4.1 Performance Indicators

A large amount of performance indicators in the Dutch perinatal care system is gathered. Data concerning pregnant women and their newborns is gathered from midwifery practices, obstetric departments in hospitals, and pediatrics by the Netherlands Perinatal Registry (Stichting Perinatale Registratie Nederland, 2011). This registry collects data regarding the characteristics of pregnant women (such as age and ethnicity), characteristics of the newborns (such as gender and weight), the pregnancy itself (such as complications as hypertensia, diabetis and smoking), the delivery (such as place of birth and Apgar score), maternal morbidity, perinatal morbidity, the organization of care (such as number of midwives and obstetricians) and data regarding who took care of pregnant women (where in the system do they start, are they referred to another organization and where do they end). In addition, in 2008, the Netherlands introduced 35 performance indicators that are a representation of the quality of care in obstetric departments (Kooistra et al., 2008). In addition to some of the indicators that are also collected by the Netherlands Perinatal Registry (such as number of caesarean sections) some structural indicators are included. Structural indicators focus on the organization of the delivery of care, such as the existence of certain procedures, structural meetings, and additional education for obstetricians. In 2007, a questionnaire (the Consumer Quality Index) is developed for measuring the satisfaction of clients (Wiegers, 2009). The questionnaire focuses on all aspects of the care process for pregnant women and their newborns: from preconception to maternity care. The use of the CQ-index is voluntarily.

4.4.2 Successes

The Dutch perinatal care system is often set as an example to learn from, for example in the United Kingdom and the United States (De Vries et al., 2009; Johnson et al., 2007; Wagner, 2006; Bradley and Bray, 1996; Mander, 1995; Oppenheimer, 1993). Why? The percentage of home births is exceptionally high (30% in 2004) (Anthony et al., 2005), compared to, for example, the percentage in the United States (2%) (Young, 2008). In addition, the number of obstetric interventions is low compared to neighboring countries (Amelink-Verburg et al., 2007), and certainly compared to the United States, where six of the fifteen most performed hospital procedures in the entire population are associated with childbirth

(Sakala and Corry, 2008). And although the overall cesarean section rate rose from 8.1% to 13.6% between 1993 and 2002 (Kwee et al., 2007), the Netherlands still has one of the smallest number of cesarean deliveries in the world (for example compared to 30% in the United States) (QuickStats, 2005).

From a cost perspective, the Dutch perinatal system appears to be working fairly well. The costs associated with pregnancy and childbirth in 2007 were about 2.4% of total healthcare expenditure (Slobbe et al., 2011). Hospitals are responsible for just over 50% of the total perinatal care costs, postnatal care is responsible for almost 25% (Hoekstra, 2008). The costs associated with a normal delivery in the Netherlands are one of the lowest of eight European countries (Bellanger and Or, 2008).

The midwifery model on which the Dutch perinatal care system is based, is appealing not only because in that case low-risk pregnant women do have a choice for being cared for in a non-medical setting, but also because a system which only delivers perinatal care in a medical setting does not have the best performance (De Vries and Niewenhuize, 2011).

4.4.3 Flaws

In 2003 the first EURO-PERISTAT study was published. Promoting healthy pregnancy and safe childbirth is a goal of all European healthcare systems. To improve outcomes, there need to be tools to assess perinatal health problems and their causes and tools to monitor the impact of policy initiatives over time. The EURO-PERISTAT study is a first step towards providing Europe with such a tool. It brings together statistical information on the characteristics, health, and healthcare of pregnant women and their newborn babies in 25 member states of the European Union and Norway. Since the first results of this study in 2003, more and more flaws of the Dutch perinatal care system have been revealed (see also EURO-PERISTAT, 2008). Firstly, the Dutch perinatal care system has relatively high perinatal morbidity and mortality rates (Mohangoo et al., 2008; Buitendijk et al., 2003). As such, regarding fetal mortality (22 weeks – birth), the Netherlands was ranked 24 out of 26, and 18 out of 26 regarding neonatal mortality (birth – 27 days) (EURO-PERISTAT, 2008).

Secondly, the Dutch perinatal care system has relatively high maternal morbidity and mortality rates (Schutte et al., 2008; Zwart et al., 2008b; Steegers, 2005). The overall maternity rate rose from 9.7 per 100 000 births in 1983-1992 to 12.1 in 1993-2005 (Schutte et al., 2009), and is now the 18 highest (out of 25) in Europe (EURO-PERISTAT, 2008). The incidence rate of some types of severe maternal morbidity (such as eclampsia) is worrying (Zwart et al., 2008b).

Thirdly, the satisfaction of pregnant women is not as high as one would strive for. The quality of care experienced by women during the care process is high (Wiegers, 2009).

However, it is often different for the labor itself. More than 16% looked back negatively to giving birth 3 years after delivery (Rijnders et al., 2008). One of the factors related to the risk of being dissatisfied with the birth event is having a referral from home to the hospital while in labor (Rijnders et al., 2008; Christiaens, Gouwy and Bracke, 2007). In case of a referral, the women changes care givers: from being cared for by a midwife who is familiar to her, she will be cared for by an obstetrician, residents and nurses who she might have never met. Although there is also research that shows no effect of a referral during delivery on the satisfaction (Wiegers, Van der Zee and Keirse, 1998b). Furthermore, home births lead to higher satisfaction than hospital births that were planned in advance, and hospital births after a referral from home score the lowest (Christiaens, Gouwy and Bracke, 2007).

4.5 Root Causes of Malfunctioning

Although some state that the Dutch numbers on maternal and perinatal morbidity and mortality are higher due to its detailed data collection system, which is more thorough than in other countries (Achterberg, 2005) or due to different interpretation of definitions (Mohangoo et al., 2008), possible explanations are also found in other aspects. The root causes for the malfunctioning in Dutch perinatal care can be put in three categories; the characteristics of the pregnant women, the efficiency of the system, and whether or not the structure of the system is the right one.

4.5.1 Root Cause 1: Characteristics of Pregnant Women

Characteristics of the pregnant women, such as ethnicity, income, smoking, age, twin births, obesity, and less use of prenatal screening compared to other countries, might be the cause of the higher perinatal and maternal mortality and morbidity rates (Zwart et al., 2011; Advies Stuurgroep Zwangerschap en Geboorte, 2009; Achterberg, 2005; Bais, Eskes and Bonsel, 2004). For example, women with a non-Western ethnic background have an increased risk at severe maternal morbidity (Zwart et al., 2011).

4.5.2 Root Cause 2: Efficiency of the Current System

The second category concerns the efficiency of the current system, which appears to be not optimal. Research shows that in 79% of maternal death cases substandard care was identified (Amelink-Verburg et al., 2012; Van Dillen et al., 2010b). Firstly, regarding the availability, both obstetricians and midwives are not available 24 hours per day, 7 days per week, which results in delays in treatment. Obstetricians are not in the hospital at evenings and in the weekends and have to be called in by residents (De Graaf et al., 2010). Midwives do not stay the whole time with a pregnant woman who is in labor. In the beginning, s/he will make visits every four hours, and the pregnant woman is supposed to call in between when complications arise. As a result of this delay, a referral to a hospital might come too

late (Reuwer, 2008). In addition, the time it takes for a woman to go from home to a hospital is different for different regions in the Netherlands and has an effect on the outcomes (Ravelli et al. 2011). Secondly, regarding the competences of staff, there are doubts about the competences of midwives to identify complications during labor (Van Dillen et al., 2011; Bonsel, Birnie, Denktas, Poeran and Steegers, 2010; Amelink-Verburg and Buitendijk, 2010; Reuwer, Bruinse and Franx, 2009). Thirdly, the information that is given to pregnant women concerning pregnancy, risks, healthy living etcetera. can be unclear and ambiguous (Advies Stuurgroep Zwangerschap en Geboorte, 2009). Fourthly, a lack of clarity about who should take the lead and inadequate communication are found to play a major role (Amelink-Verburg et al., 2012). And lastly, groups at higher risk for complications during pregnancy should be better identified early in pregnancy or before conception (Schutte et al., 2009).

4.5.3 Root Cause 3: Is the Current Structure of the Perinatal Care System the Right One?

The third root cause is where this research focuses on: on the doubts about whether the current structure of the system (i.e. midwifery practices are responsible for low-risk pregnant women and hospitals are responsible for high-risk pregnant women) is the right system (Bonsel, Birnie, Denktas, Poeran and Steegers, 2010). The discussion on the structure of the system is polarized; maintaining a clear distinction between primary and secondary care (Croon and Schagen, 2008), or moving towards integrated, transmural care (Vissers and Steegers, 2008; Nijhuis, 2008; Burggraaff et al., 2003; Reuwer and Bruinse, 2002; Meuwissen, 1979).

Meuwissen already proposed back in 1979 to create obstetric centers where midwives, obstetricians, general practitioners, and pediatricians work together. Care can be provided both in the hospital and on location, but the focus should be on professionals collaborating in order to provide the care that the women and her child need (Meuwissen, 1979). However, these obstetric centers never have been put into practice. The main reason for this is that the Dutch perinatal care system adheres strongly to the midwifery model of care. As a result, professionals are reserved towards diagnostics and medical interventions. Therefore care to pregnant women is primarily delivered in primary care and only when medically necessary in secondary care (Poorter, 2005). Combining primary and secondary care in one organization, as proposed by Meuwissen, did not fit well in this policy and in the – at that time – culture in the perinatal care sector.

However, in the last decade, more and more doubts raise about the structure of the current perinatal care system (Burggraaff et al., 2003) because of the following. Firstly, capacity problems of midwives dangers home deliveries and quality of care. Secondly, it becomes harder and harder for independent midwives to adhere to retraining, visitations, and audits.

Thirdly, the technological developments, the changing attitude of pregnant women and the fear of responsibility in case something goes wrong, result in more and more consultations in secondary care, in fragmented care and in an undeserved loss of trust in primary care. In addition, in hospitals, due to the medicalization of pregnancy, the number of obstetric interventions increases, without the expected beneficial results. Lastly, there where collaboration exists between primary and secondary care professionals, often the collaboration is sub-optimal due to distrust and feelings of competition. As a result, in a North-Eastern province of the Netherlands, an integrated perinatal care system is put into practice and the results are promising (Burggraaf et al., 2003).

For some professionals, integrating primary and secondary perinatal care services into one organization equals creating large "birthing factories", something that some professionals strongly reject (Croon and Schagen, 2008). Croon and Schagen make reference to research that states that good psychosocial care during pregnancy and continuity of care during delivery do increase the quality of care and result in high satisfaction rates. This type of care can best be delivered in a home-like environment or in a small, personal setting. However, it has to be noted that integration does not necessarily equals concentration (Van Dillen et al., 2010a; Koenen, 2010).

In addition, controversy exists about the safety of home deliveries, especially because of the time it takes to transport a woman in labor from home to the hospital in case of complications. Some state home births are as safe as hospital births (De Jonge et al., 2009), while others doubt this (Evers et al., 2010; Visser and Steegers, 2008).

4.6 The Way Forward

In 2009, a task force has been bought into being by the Department of Health to come up with improvements (Advies Stuurgroep Zwangerschap en Geboorte, 2009). Their analysis shows that the most important cause of perinatal deaths are biological problems with the mother, such as unhealthy habits, and becoming pregnant at a relatively later age. However, they also show that about 25% of the perinatal deaths might be caused by non-optimal perinatal care. In summary, their recommendations are:

1. The needs and wishes of mother and child should be leading in the care delivery process, not only their medical needs, but also their psychosocial needs.
2. Women should start healthier and better prepared at their pregnancy; risks and complications during the pregnancy can be reduced when taking care before being pregnant. Therefore, pre-conceptual consultations should be offered.

3. Women should receive clear and unambiguous information concerning pregnancy, risks, healthy and living on time.
4. Healthcare professionals should collaborate; they should develop guidelines concerning quality, they should participate actively in Obstetric Co-operative Groups. In addition, every woman should have a case manager, a birth plan and an obliged home visit during her pregnancy.
5. Specific attention should be given to women from low income communities.
6. Women should not be left alone anymore while being in labor.
7. Medical care has to be available within 15 minutes, 24 hours and 7 days a week.

4.7 Summary, Limitations, and Concluding Remarks

4.7.1 Summary

This chapter focused on the first phase of this research, on what goes wrong in Dutch perinatal care. The current design of Dutch perinatal care is based on principles of the focused factory concept: the population of pregnant women is split in low-risk and high-risk pregnant women, with low-risk pregnant women being cared for by midwifery practices, and high-risk pregnant women being cared for by obstetric departments in hospitals. Although Dutch perinatal care performs well regarding the number of obstetric interventions, the number of home births, and overall costs, it does not perform well regarding perinatal and maternal morbidity and mortality. In addition, the satisfaction of pregnant women with the care they receive is not as high as one would strive for.

Reasons for this malfunctioning can be found in firstly, the characteristics of pregnant women, such as age, smoking, ethnic background, in secondly, the efficiency of the current system, such as the availability of professionals 24/7 and the competences of professionals, and in thirdly, the structure of the system: should one have a clear distinction between midwifery practices and hospitals, or should one need to move more towards integrated care? Recommendations on how to improve Dutch perinatal care are provided by the Department of Health.

4.7.2 Limitations

This research argues that the Dutch perinatal care system is set up in line with principles of the focused factory concept. A possible criticism is that the system was never explicitly set up as a focused factory, because the concept of the focused factory was just emerging in the 1970s, when the organisation of the perinatal care sector was being formalised by national government. Does this research not try to retrofit the focused factory model onto a system that has been in operation for many years, quite independently of any operations

management theory? It is true that the formalisation of the Dutch perinatal system by law (Structuurnota, 1974) occurred in the same year as Skinner's focused factory paper was published (Skinner, 1974), and that the law does not make any explicit reference to the operations management literature, as this was just emerging at the time. However, this does not affect the fundamentals of this research. Irrespective of whether or not Dutch policy makers were aware of the literature, the fact remains that they very much acted in the spirit of the focused factory concept. A deliberate "process choice" decision was made by Dutch policy makers to organise this healthcare system from the ground up as consisting of one set of organisations and professionals serving one type of pregnancies (low-risk) and another, completely separate set of organisations and professionals serving another type of pregnancies (high-risk). Training levels, certification procedures, work methods, etcetera were all set up in line with this dual system, and all in line with the focused factory concept.

4.7.3 Concluding Remarks

The recommendations made by the Department of Health to improve Dutch perinatal care mainly on the current care *process*, not so much on the underlying *structure*. Even when the recommendations are put in place, there will still be a system where pregnant women flow from one organization (midwifery practices) to the other (hospitals) and vice versa. And as a result, the accompanied problems might still exist. Stated differently, by focusing on these seven improvements, one might make the wrong system more effective (Seddon, 2008). This research aims to gain a better understanding about the role of the inter-organizational design (the split between midwifery practices and obstetric departments in hospitals) on the performance of Dutch perinatal care.

Chapter 5.

Limits to the Design of Dutch Perinatal Care

This chapter is based on

Pieters, A.J.H.M., Van Oirschot, C., & Akkermans, H. (2010). No cure for all evils. Dutch obstetric care and limits to the applicability of the focused factory concept in health care. *International Journal of Operations & Production Management*, 30(11), 1112-1139.

5.1 Introduction

Dutch perinatal care has been designed in line with principles of the focused factory concept for several decades: low-risk pregnant women are being cared for by midwifery practices, high-risk pregnant women by obstetric departments in hospitals (as is described in Chapter 4). In the last decade, more and more flaws of the Dutch perinatal care system have been coming up, as a result of European studies which suggested that the Dutch healthcare system had some of the worst performance outcomes in Europe regarding perinatal and maternal morbidity and mortality (EURO-PERISTAT, 2008). As is described in Chapter 4, causes are found in maternal characteristics and in the efficiency of the current system. However, there are also doubts about whether the current structure of the system is the right one. This brings us to the following research questions:

RQ 1.a. *Is the design of Dutch perinatal care working well?*
RQ 1.b. *If it is not working well, why is that?*

This chapter is organized as follows. In Section 5.2 the research methodology is outlined, as well as the evaluative framework. An analysis of the findings is presented in Section 5.3, and 5.4. In Section 5.5 some concluding remarks on the structure, on the inter-organizational design of Dutch perinatal care are given.

5.2 Research Method

Dutch perinatal care is designed in line with principles of the focused factory concept (see Section 4.3). To research whether or not the organizational design concept of Dutch perinatal care is working well is to assess the applicability of the focused factory concept to Dutch perinatal care. As is discussed in Chapter 3, from an operations management/strategy perspective, in order to achieve great performance, there should be a high internal and external fit (see also Figure 5-1). Here, internal fit refers to what degree the Dutch perinatal care system will be internally consistent; external fit refers to what extent internal processes will be aligned with the characteristics of the medical condition, i.e., pregnancy, and the institutional environment. With the help of archival data analysis regarding flows of pregnant women between a midwifery practice and a hospital in the region of Tilburg, insight will be gained in whether or not Dutch perinatal care is operating according to its design and if not, what the reasons might be for this. The first research question will be answered by focusing on internal fit, the second research question will be answered by focusing on the external fit.

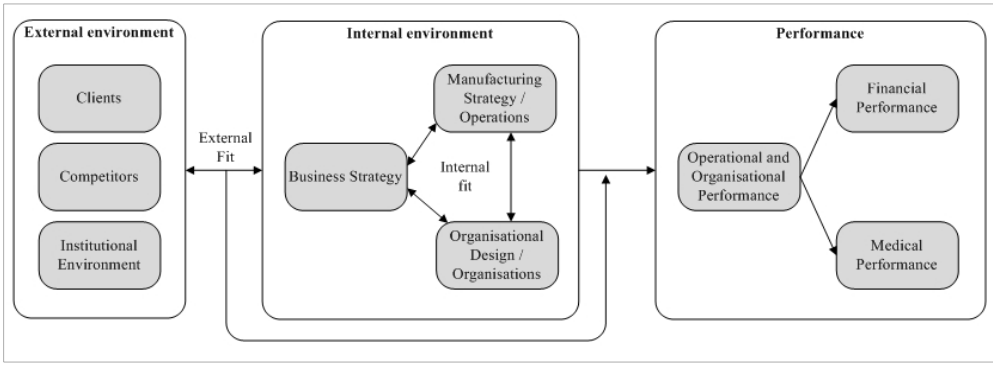

Figure 5-1 The integrated model of fit

5.2.1 Evaluation Instrument

To research whether or not the organizational design of the Dutch perinatal care system is working well, is to investigate the internal fit of the system. Investigating the internal fit in Dutch perinatal care is to assess the degree of fit between how the Dutch perinatal care system is designed and how it actually operates. Dutch perinatal care is designed in line with principles of the focused factory concept. The entire focused factory concept is based on the notion that it is possible to split up customer groups and have them served by separate organizations throughout the whole process without customers from one organization switching to the other organization. Thus for Dutch perinatal care this implies that midwifery practices focus on low-risk pregnant women and obstetric departments in hospitals focus on high-risk pregnant women, and that there should not be too many transfers between the two types or organizations. In addition, regarding staff, in theory one would expect that consultations in obstetric departments in hospitals are conducted by obstetricians ("high" skilled staff for high-risk pregnancies), and that consultations in midwifery practices are conducted by midwives ("low" skilled staff for low-risk pregnancies). Although for the latter one this is kind of obvious, there are only midwives working in midwifery practices.

Thus in order to have high internal fit in the system, one would expect the following expectations (E) with regard to how the system operates:

E1. The less pregnant women from the midwifery practice have to be consulted by staff from the obstetric department in the hospital, the more Dutch perinatal care operates according to its design.

E2. The more the obstetric department in the hospital takes care of only high-risk pregnant women, the more Dutch perinatal care operates according to its design.

E3. The more the midwifery practice takes care of only low-risk pregnant women, the more Dutch perinatal care operates according to its design.

E4. The more consultations in the obstetric department in the hospital are conducted by obstetricians, the more Dutch perinatal care operates according to its design.

If the Dutch perinatal care system does not work well, to investigate why it is not working well is to investigate the external fit. Investigating the external fit of the Dutch perinatal care system is to assess the degree of fit between the external environment and the way Dutch perinatal care is designed (internal environment). The external environment consists of the clients (pregnant women) with a certain condition (pregnancy) and the institutional environment. Here, the condition "being pregnant" is discussed in more detail, even as the behavior of customers and the organizations themselves.

5.2.2 Site Selection Process

Case data selection in this research was conducted at two levels, making this a segmented case study design (Yin, 2003). First, a selection of all pregnant women in the Netherlands was made by focusing on pregnancies in 2007 within the population of Tilburg (the sixth city of the Netherlands by inhabitant count) and its surrounding villages (a total of 4,500 births in 2007). There are very few regional differences between the regional perinatal care systems in the Netherlands. The Dutch perinatal care system has been organized more or less the same throughout the Netherlands. The structure, the financial system, and the decision criteria to decide which category a pregnant woman belongs to: all these are determined at a national level.

Second, from the two hospitals and twelve midwifery practices that provide perinatal care in the region of Tilburg, one hospital and one midwifery practice were selected. The two hospitals are fairly similar in size and composition of its population. The selected midwifery practice was one of the three largest midwifery practices in the region, according to its number of registrations. In 2007, six midwives (and four stand-ins) cared for 330 deliveries. Its size and therefore the availability of sufficient files was one of the reasons for its selection; the other was its geographical proximity to the selected hospital, which caused the vast majority of the population of this midwifery practice to consult this hospital. The selected hospital was, as 44% of the obstetrical departments in the Netherlands are, a training hospital (Zwart et al., 2008b). In 2007, the selected hospital employed eight obstetricians, eight residents, one clinical midwife and three specialized nurses. In total, 1368 babies were born here, roughly the same number as in the other hospital in the city.

5.2.3 Data Collection and Data Analysis

In order to evaluate the Dutch perinatal care system according to the characteristics described above, core data of the care process were needed. This included detailed data on individual consultations during pregnancy, and detailed data regarding delivery. Many different disciplines are involved in the perinatal care process, such as midwives,

obstetricians, residents, general, obstetric and maternity nurses, pediatricians, ultrasound scan specialists and others. However, midwives and obstetricians (and their residents) perform the bulk of the activities. They remain the chief responsible staff for the care process, and it is around their division of labor that the focused factory strategy is implemented. Therefore, data collection has focused on these two groups, and not on the other healthcare professionals involved.

Data collection proceeded as follows. Data of pregnant women who were due to deliver in the year 2007 were filtered from the electronic databases of the hospital and the midwifery practice, a research design that Yin (2003) calls "population research". Unfortunately, and perhaps symptomatic for the focused factory organization of the perinatal care system, data were stored in different ways in the hospital and the midwifery practice. In the hospital, data about consultations during pregnancy was stored electronically, while data concerning the delivery was stored in a paper book. In the midwifery practice, data about the consultations and home births was stored electronically, while data concerning hospital deliveries was stored in the same paper book as just mentioned. The electronic systems of the hospital and the midwifery practice were incommensurable. Therefore, data from different sources referring to one and the same client had to be put together manually based on initials, surname, birth date of the pregnant women, and the expected due date.

For every pregnant woman, data was collected on the medical condition at the start of the pregnancy, on the consultations during the pregnancy, on the delivery, and on the official transfer from the midwifery practice to the hospital, if this occurred. Regarding the consultations, the following information was collected: the number of consultations, the person conducting the consultation (by profession (midwife, obstetrician, resident) and by name), and the time of the consultation in the pregnancy (week). Regarding the delivery, data was collected on who supervised the delivery (midwifery practice or hospital), where the place of birth was (home or hospital), and on the time of the delivery in the pregnancy. All collected data were stored in a computer database program. Table 5-1 displays the data used in the analysis. At the end of this data collection process, the quality of the data appears to be rather good. There are no signs of the electronic records being incomplete with respect to the information relevant for this research. For instance, cross-checking of data from hospital and midwifery practice did not point to any consultations not being recorded, nor to the person who conducted the consultation not being logged.

This resulted in a total of 2101 pregnancies (Table 5-1). Not all pregnant women in the databases were included in the study. Only those who received care during their whole pregnancy and their delivery from either the selected hospital, the selected midwifery practice or from both were included (group 1 to 4). The following women were excluded from the study (group 5): women who also received care from other hospitals or midwifery

practices than the selected ones, women who did not give birth due to miscarriage, and women who did not receive care during their entire pregnancy from the selected hospital and/or midwifery practice (for example, women who moved away from the region, or women who moved into the region).

Table 5-1 Overview groups of pregnant women in data analysis

Group	Description of pregnant women	#	%
Group 1	Started in the midwifery practice, cared for only by the midwifery practice	66	3.1%
Group 2	Started in the midwifery practice, cared for both by the hospital and the midwifery practice	224	10.7%
Group 3	Started in hospital, cared for only by the hospital	422	20.1%
Group 4	Started in hospital, cared for by both the hospital and the midwifery practice	25	1.2%
Group 5	Remainder*	1364	64.9%
	Total number of pregnancies in case sample database	2101	100%

* All women with a referral in their data to other hospitals or other midwifery practices and/or who did not complete their pregnancies.

5.3 Findings 1: Internal Fit?

This section presents the findings regarding the first research question: Is the design of the Dutch perinatal care sector working well? Answering this question is to investigate the internal fit of the system. Investigating the internal fit in Dutch perinatal care is to assess the degree of fit between how the Dutch perinatal care system is designed and how it actually operates. The findings are presented below, organized by the expectations regarding the way Dutch perinatal care should operate.

E1. Transfer of pregnant women from midwifery practice to the obstetric department in the hospital.

One would expect that the less pregnant women from the midwifery practice have to be consulted by staff from the obstetric department in the hospital, the more Dutch perinatal care operates according to its design. Here, the data do not suggest a good “fit” between the design and the actual operations of Dutch perinatal care, on the contrary.

As is shown in Figure 5-2, 77% (19% + 58%) of the pregnant women who start in the midwifery practice (group 1 and 2) eventually become – temporarily or permanently – high-risk ones. In fact, Figure 5-3 shows that for those women who have consultations in the hospital (group 2), one out of three visits is to the hospital.

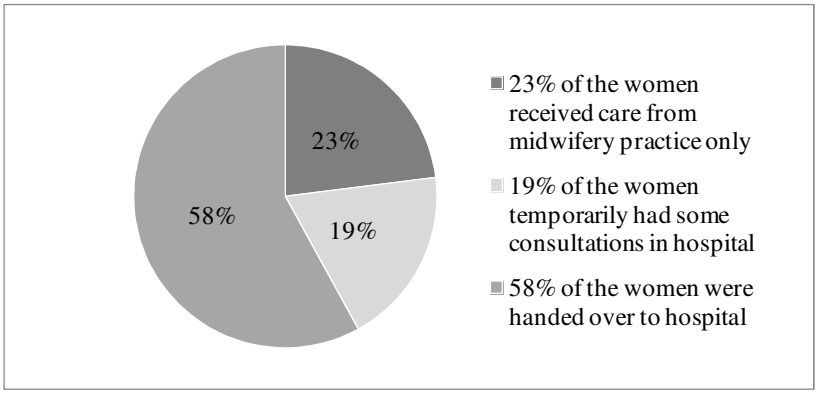

Figure 5-2 Organizations that provided care to pregnant women who start in the midwifery practice (group 1 and 2, 490 women)

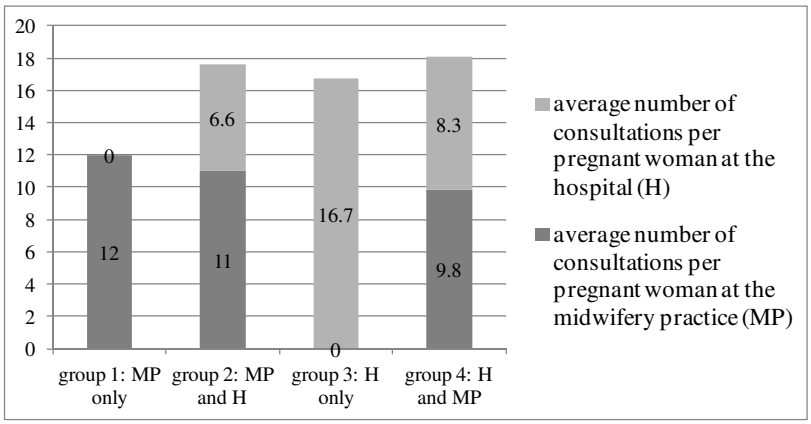

Figure 5-3 Average number of consultations per pregnant woman per organization

In addition, just over 5% of the pregnant women who start in the hospital have also consultations in the midwifery practice. This group consists of two types of pregnant women. Firstly, one can discern pregnant women who are categorized as low-risk and who are sent to the midwifery practice but develop a high-risk somewhere along the pregnancy and are referred back to the hospital again. Secondly, one can discern pregnant women who have a special risk: they can be cared for in the midwifery practice for a long time, but

towards the end, they will need care from an obstetrician. This is an agreed care pathway by both midwives and obstetricians. However, having a designated care pathway which consists of being cared for both by midwifery practices and hospitals is not in line with the principles of the focused factory concept.

Clearly, the bulk of the women who start at the midwifery practice tend to have multiple consultations in the hospital. As such, this flow of operations is not in line with the focused factory concept.

E2. High-risk pregnant women in the obstetric department in the hospital

One would expect that the more the obstetric department in the hospital takes care of only high-risk pregnant women, the more Dutch perinatal care operates according to its design. Here, we zoom in on those women that were, from the start, cared for in the hospital. A fully trained and experienced obstetrician reassessed the medical statuses of these 422 women at the start of their pregnancies. On the basis of the officially specified medical criteria for whether a woman should be treated by a midwifery practice, the obstetric department in the hospital or by both, she came to the assessment shown in Figure 5-4. According to this assessment, almost 40% of the pregnant women did not needed to have followed the "hospital" care path at all, and another 13% of the population should have been cared for first by the midwifery practice, and only towards the time of the actual delivery by the hospital, rather than by the hospital from the start.

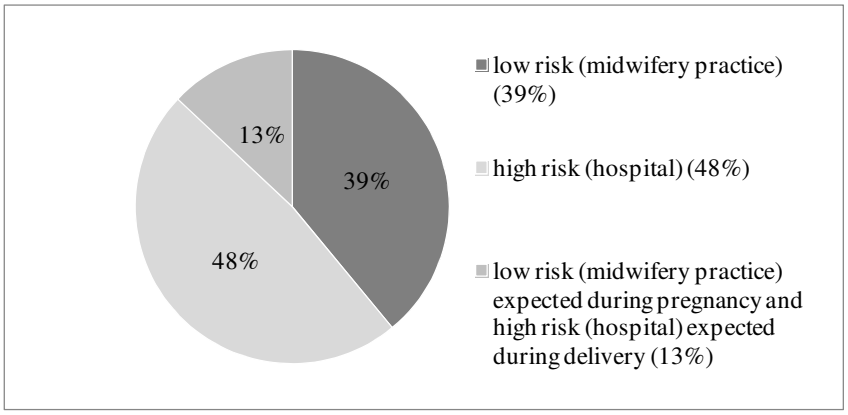

Figure 5-4 Risk profile directly after initial assessment in the hospital (Group 3, 422 women)

Thus, of the women only cared for in the hospital (group 3), just over half of the population, or 52% (13% + 39%), should have been redirected to a midwifery practice based on their initial risk profile. Thus, if half of the pregnant women that reside in the "hospital" process should actually be in the "midwifery" process, there is no fit between the design of Dutch perinatal care and the way it actually operates, in this regard.

E3. Low-risk pregnant women in the midwifery practice.

One would expect the more the midwifery practice takes care of only low-risk pregnant women, the more Dutch perinatal care operates according to its design. We do know that 77% of the pregnant women that are being taken care of by the midwifery practice have some consultations in the hospital (Expectation 1). This might imply that the referral process of the midwifery practice to the hospital works well and that indeed the midwifery practice only takes care of low-risk pregnant women.

However, we also know that there are doubts about the competences of midwives to identify complications (Amelink-Verburg and Buitendijk, 2010; Reuwer, Bruinse and Franx, 2009). As a result of this, pregnant women who have developed a high-risk might be taken care of in the midwifery practice for a certain amount of time.

To conclude, if only 23% of the pregnant women that are being taken care of in the midwifery practice only have consultations in the midwifery practice, would that be a large enough number to justify having a system that is based on the principles of the focused factory concept?

E4. Obstetricians doing the work in the obstetric department in the hospital.

One would expect that the more consultations in the obstetric department in the hospital are conducted by obstetricians, the more Dutch perinatal care operates according to its design. Figure 5-5 shows that not only obstetricians conduct consultations in the hospital. On the contrary, of all consultations in our dataset, only 34% are performed by a fully qualified obstetrician. The others are performed by either a resident, a midwife employed by the hospital, or by a nurse. However, one would expect "highly" skilled staff to be doing the bulk of the work, not just a third of the work. After all, if the work can be done by "lower" skilled staff, then why is it not performed in the "midwifery" process?

The Expectations in Summary

To answer the first research question, one cannot state that there is a high internal fit in Dutch perinatal care. Dutch perinatal care does not operate according to its design. First of all, there is a fair amount of transfer of pregnant women between the two organizations:

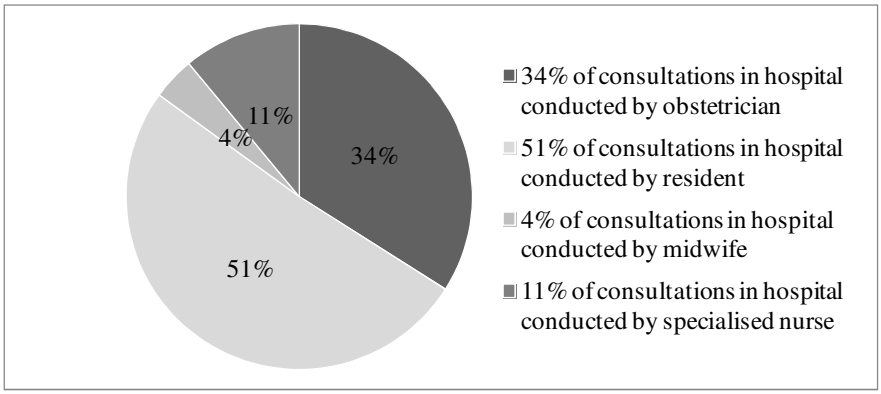

Figure 5-5 Consultations in hospitals by staff level

77% of the pregnant women who start in the midwifery practice are also taken care of in the hospital. Secondly, there is a fair amount of low-risk pregnant women being taken care of in the hospital: 40% of the pregnant women in the hospital were categorized as being low-risk, while still pursuing their care process in hospital, which should be the organization which only takes care of high-risk pregnant women. Thirdly, the midwifery practice only takes care of a very small number of pregnant women: only 23% of the pregnant women that start in the midwifery practice only receive care from this midwifery practice, the other 77% needs more specialized care. One could argue that when 40% of the pregnant women that start in the hospital and are diagnosed as having a low-risk pregnancy are indeed referred to the midwifery practice, that the absolute number of pregnant women in the midwifery practice increases. However, this does not necessary result in more "low-risk only" pregnant women; it is fair to assume that of these 40% also about 77% needs a consultation in the hospital somewhere along the line. Finally, in the obstetric department in the hospital, the obstetricians only conduct 34% of the consultations; the rest is conducted by lower skilled staff as residents, midwives and nurses. If most of the work in the hospital can be done by "lower" skilled staff, why would it be efficient to have a system where two organizations are conducting "lower" skilled consultations? As such, we conclude that the design concept of Dutch perinatal care is not working well. This is also summarized in Table 5-2.

Table 5-2 Overview of expectations, conclusions, and data used

Expectation	**Data used / collected**	**Conclusion**	**G ***	**DS ****
E1. The less pregnant women from the midwifery practice have to be consulted by staff from the obstetric department in the hospital, the more Dutch perinatal care operates according to its design.	Calculation of number of consultations and by who they are conducted (hospital or midwifery practice).	High percentage of women that have to be consulted in the hospital.	1 2	MP H
E2. The more the obstetric department in the hospital takes care of only high-risk pregnant women, the more Dutch perinatal care operates according to its design.	Retrospective review of the assessments of pregnant women by an obstetrician. Pregnancies classified as low-risk or high-risk.	The population of pregnant women in the hospital is a mixed one, both low-risk and high-risk pregnancies are being cared for.	3	H
E3. The more the midwifery practice takes care of only low-risk pregnant women, the more Dutch perinatal care operates according to its design.	Calculation of number of consultations and by whom they are conducted (hospital or midwifery practice) and literature.	Midwifery practice probably takes care of low-risk pregnant women only. But only 10% of the midwifery population is low-risk only.	1 2	MP H
E4. The more consultations in the obstetric department in the hospital are conducted by obstetricians, the more Dutch perinatal care operates according to its design.	All consultations are grouped by staff type.	The expertise level of staff in the hospital is relatively low.	2 3 4	H

* G = Group, see Table 5-1.
** DS = Data Source (MP: Midwifery Practice, H=Hospital)

5.4 Findings 2: External Fit?

In the previous section it is concluded that the design of Dutch perinatal care does not work well. This section presents the findings on the second research question: why is the design not working well? Answering this question is to investigate the external fit. Investigating the external fit of the Dutch perinatal care system is to assess the degree of fit between the external environment and the way Dutch perinatal care is designed (internal environment). Our analysis has yielded four potential root causes (RCs) that all point to a lack of fit between external and internal environment; i.e., a lack of fit between the characteristics of the "customers" in this healthcare context (pregnant women) and the institutional context on the one hand, and the strategy, organization and operations of the perinatal care system on the other hand. All four causes are explored in more detail below.

RC1: The ex ante predictability of which pregnant women will turn out to fall in the category low-risk or high-risk is low.

Evidently, it is a medical "fact of life" that it cannot be known at the initial assessment if a pregnancy will develop as a low-risk or a high-risk case. There are some main risk identifiers to identify high-risk pregnancies beforehand, but the majority of pregnancies start out classified as a low-risk one. However, in our sample, 77% (19% + 58%) of these low-risk pregnancies eventually become – temporarily or permanently – high-risk ones (Figure 5-2). This is in line with the overall Dutch experience. Broadly speaking, in the Netherlands 80% of the women who are pregnant for the first time start at the midwifery practice, but over the course of their pregnancy 75% of those end up in hospital at some point (Reuwer, Bruinse and Franx, 2009; Amelink-Verburg et al., 2007).

RC2: Pregnancy and delivery always require both care and cure

Even in the hypothetical case that one could establish beforehand with perfect accuracy into which category (low- or high-risk) a pregnancy will fall, the operations of the system would still be misaligned with the principles of the focused factory concept. By its very nature, the process of being pregnant regularly requires both *care* and *cure*. This works in two ways. A low-risk pregnancy occasionally requires *cure*; of all women who start at the midwifery practice, 77% require some specialist care at some point (Figure 5-2). Also, a high-risk pregnancy also requires *care*, as is described in Chapter 4.

RC3: The institutional split creates organizational inertia and stickiness

The Dutch perinatal care system is set up as a tiered system consisting of midwifery practices and hospitals. These are both capable of serving low-risk pregnancies (see Expectation 2). This organizational "solution" becomes a root cause itself for why not all the low-risk pregnancies remain in one part of the system. First, any split in organizational divisions inevitably leads to some degree of inertia, to "stickiness" and to reluctance to

hand over clients. Second, there is a fundamental difference in how midwives and obstetricians position themselves towards pregnant women. Both adhere to the philosophy that being pregnant is a natural event. However, midwives strongly focus on having a pregnancy that is as "natural" as possible, without any unnecessary medicalization. Obstetricians, on the other hand, are first and foremost trained in risk reduction; in case of doubt, their first instinct is that it is strongly advisable to have things happen in hospital. Third, the hospital we investigated is, as most hospitals in the Netherlands, a training hospital, which employs residents. These residents have to be trained in dealing with both high-risk and low-risk pregnancies. In other words, there is no inherent capacity limitation drive to "push" low-risk pregnancies out of the hospital to midwifery practices.

RC4: Preferences and behavior of pregnant women are aligned towards high-level care

The "stickiness" described for midwives and obstetricians also applies to the pregnant women themselves. Behavior and preferences of pregnant women are affected by whom they are cared for. Women with an obviously high-risk pregnancy require being seen by an obstetrician; they are not presented with a choice. By contrast, women with a low-risk pregnancy or a pregnancy that borders on being high-risk do have a choice. So when, for example, a woman becomes pregnant through in vitro fertilization, she normally has no ex ante reason to expect a high-risk pregnancy. However, as she has become accustomed to visiting "her" obstetric department in the hospital, she often prefers to not go to the midwifery practice but to continue her consultations in the hospital instead. It is worth noting that, in the Netherlands, health insurers typically do not provide clear financial incentives to influence that choice.

5.5 Summary, Limitations, and Concluding Remarks

5.5.1 Summary

This chapter focused, together with the previous chapter, on the first phase of this research. It shows that the design concept of Dutch perinatal care is not working well by investigating the internal fit: the inter-organizational *design* of the system is compared with the inter-organizational *practice* in our case setting. First of all, there is a fair amount of transfer of pregnant women between the two organizations: 77% of the pregnant women who start in the midwifery practice are also taken care of in the hospital. Secondly, there is a fair amount of low-risk pregnant women being taken care of in the hospital: 40% of the pregnant women in the hospital were categorized as being low-risk, while still pursuing their care process in the hospital, which should be the organization which only takes care of high-risk pregnant women. Thirdly, the midwifery practice only takes care of a very small number of pregnant women: 23% of the pregnant women that start in the midwifery

practice only receive care from this midwifery practice, the other 77% also need more specialized care. Finally, in the obstetric department in the hospital, the obstetricians conduct only 34% of the consultations; the rest is conducted by "lower" skilled staff as residents, midwives and nurses. If most of the work in the hospital can be done by lower skilled staff, why would it be efficient to have a system of focused factories where two different types of organizations offer lower skilled consultations?

The reason why the current design is not working well is answered by focusing on the external fit. Root causes for the misalignment between how Dutch perinatal care is organized and how it actually operates are the following. Firstly, the ex-ante predictability of which pregnant woman will turn out to fall in the category low-risk or high-risk is low. Secondly, pregnancy and delivery always require both *care* and *cure*. Thirdly, the institutional split between midwifery practices and hospitals creates organizational inertia and stickiness. And fourthly, preferences and behavior of pregnant women are aligned towards high-level care (*cure*).

5.5.2 Limitations

The research method applied is that of archival data analysis regarding the flow of pregnant women. Data from pregnant women from a particular year from one hospital and one midwifery practice are collected: data on individual consultations during pregnancy, and detailed data regarding delivery. Some limitations. Firstly, the case setting is a training hospital, which employs both experienced obstetricians and less experienced residents. Would results have been different if we had chosen a non-training hospital? Since then there would not be any residents be employed. Doing so would only introduce another bias: that of specialist staff (obstetricians) dealing with simple jobs, as certainly not all consultations for high-risk pregnancies require highly specialised skills. Second, there are about as many hospitals that are training hospitals for obstetric care as there are hospitals that do not have training facilities (Zwart et al., 2008a). Thus, our case setting is just as representative for the Dutch perinatal care system as any non-training hospital might be.

Secondly, this archival data analysis is done in retrospect and an obstetrician determined, based on the information available at the intake, the initial risk level of the pregnant women in the hospital. For all other consultations, we did not have insight in whether or not the professional involved made a right call regarding the risk level. A possible limitation is that we have assumed that as long as consultations take place in the midwifery practice, the present risk level is indeed low-risk. However, literature (Amelink-Verburg and Buitendijk, 2010; Reuwer, Bruinse and Franx, 2009) shows that midwives in independent midwifery practices do sometimes lack the competences to recognize a high-risk pregnancy. Would their interpretation of the risk level have been different, the care pathway through the perinatal care system would have been different for those pregnant women. This would

have changed our data, but most likely it would not have changed the results. The current result is that the inter-organizational design of Dutch perinatal care does not work well: too many pregnant women who are being taken care of in the midwifery practice need to consult an obstetrician. If we would be able to measure the actual, instead of the by midwives perceived, number of high-risk pregnant women, only more women would be referred to an obstetrician.

5.5.3 Concluding Remarks

What this research has shown is that a focused factory approach as applied in Dutch perinatal care does not work well. There is no good fit between the design of the system and the way it actually operates. Given the root causes, the solution here is to go look for a different inter-organizational design. Since one cannot determine if a pregnancy will turn out to be a low-risk or a high-risk one, and pregnant women need both *care* and *cure*, it seems reasonable to suggest that a fully separated system does not work. Instead, one might conclude that at least better collaboration between midwives (who specialize in delivering *care*) and obstetricians (who specialize in delivering *cure*) needs to be accomplished. Literature in the perinatal care sector also suggests this. A broad base of midwives, working closely together with the specialists, will provide care to all pregnant women, regardless of the complexity of their pregnancies, all of this while putting the interests of pregnant women first (Reuwer, Bruinse and Franx, 2009). The first evaluations of such approaches in perinatal care suggest that multidisciplinary teams made up of midwives and obstetricians working together in community-based maternity clinics hold out great potential for effectiveness (Rodriguez and Rivieres-Pigeon, 2007).

However, the need for better collaboration does not give any advice yet on the inter-organizational design: should midwives and obstetricians work in separate organizations? Or should they integrate completely into one organization? Or are there other inter-organizational designs that might work? Since collaboration between professionals seems key to the issue, the next chapter will focus on inter-organizational collaboration in Dutch perinatal care.

Chapter 6.

Inter-Organizational Collaboration in Dutch Perinatal Care

This chapter is based on

Pieters, A., Akkermans, H., & Franx, A. (2011). E pluribus unum: using group model building with many interdependent organizations to create integrated health-care networks. In: J.A. Wolf, H. Hanson, M.J. Moir, L. Friedman, & G.T. Savage, (Eds.), *Organization Development in Healthcare: Conversations on Research and Strategies* (Advances in Health Care Management), 10, 321-344.

6.1 Introduction

In the previous chapter it is shown that the current design of Dutch perinatal care, that of a system in line with the focused factory concept, is not working well. Root causes for this are found in the characteristics of the condition (pregnancy), in the behavior of the pregnant women, and in the behavior of the midwives and obstetricians (organizational inertia). As is described in the literature review (see Section 2.6), collaboration between organizations and professionals is of major importance in the healthcare sector. This research focuses on the intersection of the inter-organizational design, the inter-organizational collaboration, and the patients' flow, health and wellbeing.

This chapter digs deeper into the organizational inertia by focusing on the behavior of midwives and obstetricians, on the collaboration between them, and on the effect on the care process. It is expected that their behavior has consequences for future inter-organizational design. This second phase should therefore not only provide us with insight into why the design of Dutch perinatal care is not working well (behavior of the professionals), but should also provide us with some preliminary guidelines on how to improve perinatal care. The research questions are:

RQ 2.a. *What is the status quo of inter-organizational collaboration in Dutch perinatal care?*
RQ 2.b. *What are the inter-organizational dynamics in Dutch perinatal care?*
RQ 2.c. *Are there preliminary guidelines on how to improve Dutch perinatal care?*

As is defined in Section 2.6, collaboration in this research is marked by knowledge contribution, equal distribution of power, and a focus on achieving best outcomes without regard to discipline, hierarchy, or even organizational boundaries (Kinnaman and Bleich, 2004). It is horizontal collaboration on a personal/role and macro level. It concerns collaboration in perinatal care between professionals (midwives and obstetricians) from different organizations (midwifery practices and obstetric departments in hospitals). Thus when this research refers to collaboration between organizational entities, such as midwifery practices, obstetric departments in hospitals and hospitals, the collaboration between midwives and obstetricians is referred to.

This chapter is structured as follows. Section 6.2 will elaborate on the methods used, on how the Renga method is applied in the setting of perinatal care in Tilburg. Section 6.3, 6.4 and 6.5 will present the findings to each of the three research questions and Section 6.6 presents the concluding remarks.

6.2 Research Method

The research questions are being studied by clinical research. In clinical research (Coghlan, 2009; Schein, 1987), the clinician starts with an action research model of the organization built on the assumption that the only way to understand an organization is to change it (Lewin, 1948), and that the only way to understanding, therefore, lies in deliberate intervention and the deciphering of the responses to the intervention (Schein, 1987). Thus the intervention is two-sided: to help the client improve perinatal care and to gain insight into the dynamics of inter-organizational collaboration (see also Section 3.6.1. The Renga approach is an approach by which both can be achieved (see Section 3.6.2). In addition, the researcher has been a project manager in the field. This chapter, however, only focuses on answering the three research questions as outlined above; how effective the intervention has been is not subject of this research.

6.2.1 Study Setting: Perinatal Care in Tilburg

The case setting is that of perinatal care in Tilburg and its surrounding villages, where perinatal care is delivered by two hospitals and twelve midwifery practices (see Figure 6-1 and Section 3.3.2).

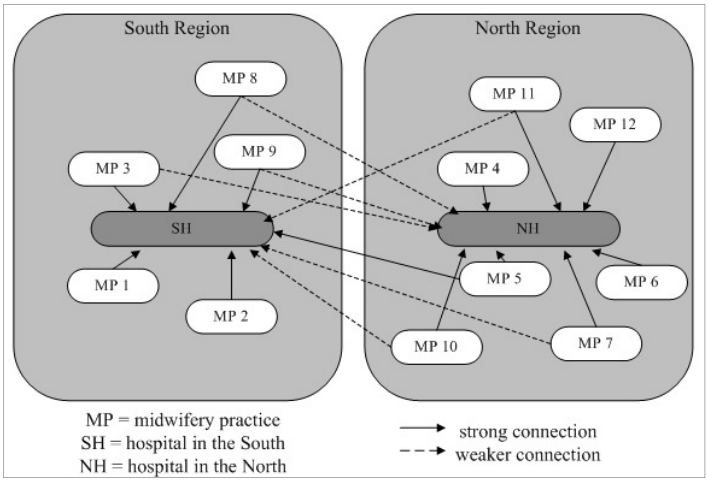

Figure 6-1 The two hospitals and twelve midwifery practices in Tilburg

In 2006, a voluntary joint project was initiated by some obstetricians of the south hospital and researchers of Tilburg University. The overarching project's goal was to improve the perinatal care process. Even though many different disciplines are involved in the perinatal care process, such as midwives, obstetricians, residents, general, obstetric and maternity nurses, pediatricians, ultra sound scan specialists and others, this project focused on obstetricians and midwives, for as they are overall responsible for the care process.

Although midwives and obstetricians communicated and collaborated in delivering care, their relation was hampered by mutual distrust and misunderstanding. As a result, creating support and commitment was seen as one of the major conditions for the project to succeed.

6.2.2 Project Phasing

The project consists of three phases. Phase A (problem analysis) corresponds to the first four steps of the Renga approach, phase B (defining improvements) to the fifth and sixth step of the Renga approach, and phase C (implementing improvements) to the seventh step (see Figure 6-2).

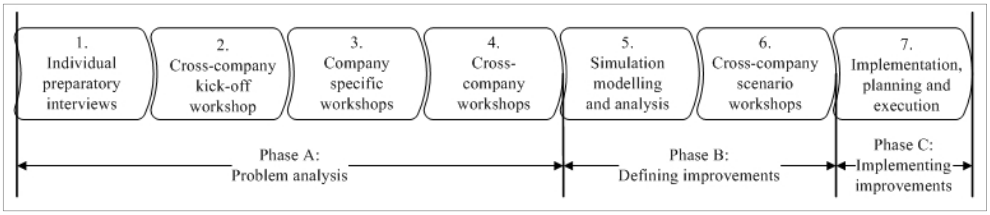

Figure 6-2 Project phasing and Renga approach

The Renga approach is adjusted for this specific research project. In phase A the Renga approach needed to be adjusted because of the number of actors involved (two hospitals and twelve midwifery practices) – the original Renga approach has only been tested for a small number of participating organizations (n=4). A design was chosen where smaller groups work together and regular feedback was given to all actors involved in plenary sessions. Figure 6-3 shows this process. In phase A, two groups were discerned: Group 1 (the pioneer group) and Group 2. Group 1 consisted of the south hospital and three midwifery practices whose pregnant women – if necessary – were predominantly referred to the south hospital for specialized care (south region). Their findings in the problem analysis phase were promising, so they presented them in a plenary session to the north hospital and to the other nine midwifery practices in the region. As a result, they also wanted to experience the same process. Group 2 was formed, consisting of the north hospital and three midwifery practices whose pregnant women were predominantly referred to the north hospital (north region).

In phase B, the improvement proposals were defined in a smaller group, consisting of key representatives of obstetricians and midwives, and feedback was given in the plenary session. Analyzing the problem and defining improvements was done simultaneously. The main reason for this was that Group 1 did not want to slow down and wait for a few months to proceed with the process. They did not want to lose the momentum that was created in the problem analysis phase. Because of close researcher participation in all phases, the researcher supervised the whole project and, where necessary, bridges between these two

phases could easily be built. In the Renga approach, improvements are defined by building a simulation model and by testing different scenarios. In this research project, the researchers and participants felt defining improvement options without simulation was the best way forward.

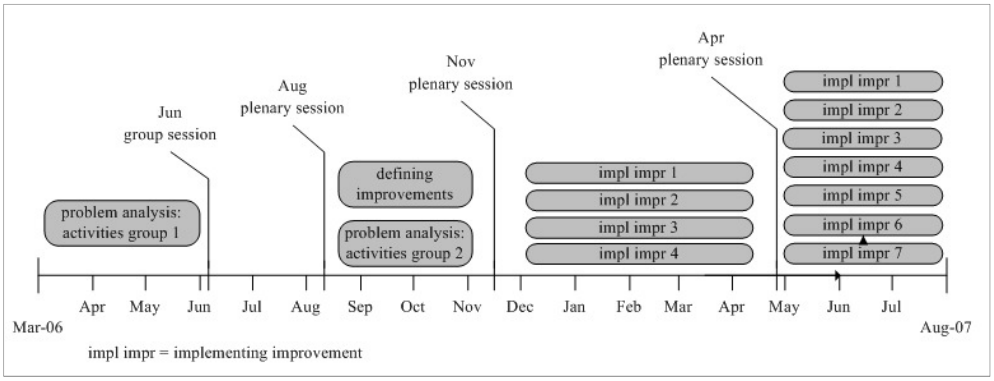

Figure 6-3 Design intervention

6.2.3 Project Activities

Phase A. Problem Analysis

In phase A the following qualitative research activities were conducted: a questionnaire for each individual, interviews and group model building sessions on an organizational level, and plenary sessions on an inter-organizational level.

The questionnaire was meant to gain a general insight into the dynamics between the midwives working in midwifery practices and the obstetricians working in obstetric departments in hospitals. Its aim was to be a preparation to the interviews and group model building sessions which followed. The questionnaire was filled in by the obstetricians and midwives individually. The questionnaire was a compilation of other questionnaires which study the existing cooperative situation of inter-firm relationships (Johnston et al., 2004; Humpreys, Li and Chan, 2003). 24 questions were asked, divided in five categories: transparency, trust, performance, power, and effort. Each question was rated on a 7-point Likert scale, where 1=I strongly disagree, 4=neutral, 7=I strongly agree. A translation of the questionnaire is attached in Appendix A.

The interviews were held on an organizational level; the two obstetric departments in the hospitals and the six midwifery practices each had their own interviews. The interviews lasted for about two hours. The interviews were semi-structured; the following questions were used as a guideline for the interview: What contributes to good collaboration? What contributes to bad collaboration? How do you notice the performance of the collaboration?

In a group model building session the hospital and midwifery practices each focused on one problem which dominated their interview. The attendees and the interviewers decided together what the dominant problem was. Causal loops diagrams were used to disentangle the problems. These diagrams were used in the group session to tell a story, to tell each other how they perceive their common world.

Group 1 and Group 2 had slightly different processes (Figure 6-4). Group 1 started with two meetings with the researcher. In the first meeting they filled in the questionnaire (Q) and had the interview (I). The second meeting was the group model building session (GMB). They presented their findings to each other in a group session (GS), and reported this session to the other hospital and midwifery practices in a plenary session (PS). As a result, Group 2 started with a plenary session, filled in the questionnaire and had their first meeting with the researchers where they were both interviewed and had their group model building session. For Group 1, the group session served as the cross company kick-off workshop (Renga, step 2) because it resulted in the commitment of the actors to continue with the project. For Group 2 (and for the group as a whole), the plenary session served as a cross company kick-off workshop.

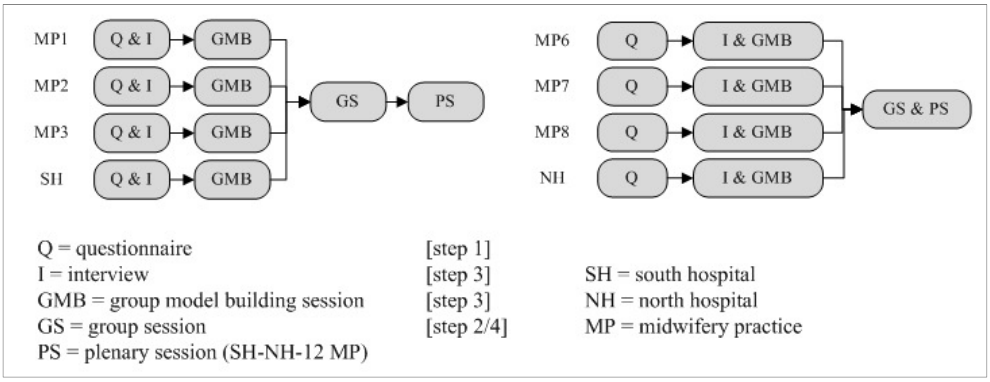

Figure 6-4 Activities in phase A

Phase B. Defining Improvements

After the first plenary session two obstetricians formulated about twenty improvement proposals for the perinatal care system in Tilburg. Each proposal was formulated in the same format (see Framework 6-1). These improvements were discussed in two sessions: first by four midwives, each from different midwifery practices, and later by four other obstetricians representing each hospital. Finally, a list of the top four improvements was compiled by looking at two criteria: easy to realize and urgency. 'Easy to realize' because achieving results in the short term motivates the actors involved and stimulates collaboration between them. 'Urgency' because some improvements are necessary because

of national developments, or because of just avoiding mistakes, misunderstandings and unnecessary actions.

Framework 6-1 Format description of improvement

- description of the improvement
- problems which are dealt with
- unwanted consequences
- hypothesis why the improvement should work
- relation with other improvements
- necessary conditions
- advantages for obstetricians, midwives, assistants, pregnant women, care process and final outcome of care
- needed efforts from obstetricians, midwives, pregnant woman and management of the hospital
- degree of advantage for pregnant women, midwife, obstetrician, resident, care process, quality of care
- level of commitment needed from obstetrician, midwife, pregnant women, management hospital

Phase C. Implementing Improvements

In the second plenary session the improvement proposals were presented and project groups were compiled, each consisting of two obstetricians (one from each hospital) and two or more midwives (from different midwifery practices). Under the guidance of the project manager (i.e. the researcher) the project groups (eight in total) worked on implementing the improvements. The project manager was responsible for coordination of meetings, follow ups, keeping momentum, and alignment between groups. Every four months, until January 2008, the project manager organized plenary sessions, where all actors involved were informed about the developments and where new improvement proposals were selected. The project manager compiled a newsletter every two months, which was send out to all actors involved. After one year, the task of the project manager was taken over by Zorgnetwerk Midden-Brabant.

6.2.4 Study Participants

In total, the obstetricians of two hospitals and midwives of six midwifery practices participated in the project. Table 6-1 shows the response rates and the attendance of the obstetricians and midwives for each of the activities in the project. For all organizations involved, continuity of the persons present was obtained, for example, attendees of the interview also attended the group model building session. Reasons why people were not present or did not respond to the questionnaire were: obstetricians not being specialized in pregnant women but in other aspects of obstetrics such as cancers, having a short term contract at the midwifery practice, being on duty, having to work, and being on maternity leave. Temporary staff (maximum of one per midwifery practice) and residents (about eight

per hospital) were excluded. Midwifery practices were selected through consultation with the obstetricians in the hospitals; the largest and geographically closest midwifery practices have been selected to participate. At the interview, the group model building session and the plenary session, two or three researchers were present: one interviewer/facilitator, who is also an experienced group model builder, and one or two recorders.

Table 6-1 Response rate and attendance numbers

	Total professionals in the organization	Response questionnaire	Attendance at the interview	Attendance at the GMB session	Attendance at the first plenary session
NH	8	7 (87.5%)	3 (37.5%)	3 (37.5%)	3 (37.5%)
SH	8	6 (75%)	4 (50%)	*	7 (87.5%)
MP 1	5	5 (100%)	5 (100%)	5 (100%)	5 (100%)
MP 2	5	3 (60%)	3 (60%)	3 (60%)	3 (60%)
MP 3	2	2 (100%)	2 (100%)	2 (100%)	1 (50%)
MP 4	6	6 (100%)	4 (66.7%)	4 (66.7%)	2 (33.3%)
MP 5	4	3 (75%)	2 (50%)	2 (50%)	3 (75%)
MP 6	5	3 (60%)	3 (60%)	3 (60%)	3 (60%)

* The south hospital did not have a group model building (GMB) session.

6.2.5 Data Analysis

Information concerning the collaboration between midwives and obstetricians is abstracted by using different methods: questionnaires, interviews and group model building workshops. The questionnaires had pre-coded response options. Data was entered in an excel file. The semi-structured interviews were not recorded, but notes were made by two persons. The participants were given the opportunity to comment on them. Afterwards, these notes were coded and collapsed into themes and categories by the researcher. The participants were given the opportunity to comment on these generalized findings in the plenary session as well. The group model building workshops resulted in ten different causal loop diagrams. The workshops were not recorded, but notes were made by two people (the interviewer/facilitator of the group model building workshops, and the researcher) and the participants were given the opportunity to comment on them. In the plenary sessions, a representative from each organization presented their own causal loop diagram to the group. Afterwards, the researchers structured the causal loop diagrams further. Some items were present in multiple causal loop diagrams, and therefore the researchers were able to link the causal loop diagrams to each other. In the plenary session feedback was given to the two hospitals and twelve midwifery practices concerning their collaboration. The researchers presented a summary of the results of the questionnaire and

the interviews, and the "owners" of the causal loop diagrams presented the diagrams themselves. The audience was given the opportunity to discuss these.

Data was gathered from two groups: the hospital in the south with three midwifery practices, and the hospital in the north with three midwifery practices. As a result, collaboration in both regions is investigated individually. However, for the purpose of this thesis, presenting the results for each region separately and discussing the dynamics in each region separately will not add valuable information. This research focuses on obstetricians and midwives in general, and not on the specific details in certain regions. As Siggelkow (2007) noted, once one gets immersed in a case and has spent considerable time reading about or observing an organization, it can easily feel that everything is "so interesting" and, as a result, should be shared with the reader. Those readers that are interested in the results of the two regions separately are referred to Appendix B.

6.3 Findings 1: Status Quo of the Inter-Organizational Collaboration

This section presents the findings regarding the first research question: What is the status quo of the inter-organizational collaboration in Dutch perinatal care? This is investigated by a questionnaire that focused on the relation between midwives and obstetricians. The results are presented in Appendix B. Overall, all parties believe there is value in collaborating together. The questionnaire consisted of different categories, of different aspects of inter-organizational collaboration: transparency, trust, performance, power and effort. A short summary is presented below.

Firstly, transparency concerns the exchange of information and feedback that is given to each other. All parties agree that it is expected to keep the other informed about events or changes that may affect the other. However, in practice, it seems that midwives provide the obstetricians with more information than the other way around. Secondly, in general, midwives and obstetricians trust each other, although midwives have more confidence in the relation than obstetricians have. Thirdly, midwives and obstetricians believe that the prerequisites for improving performance are in place; the relationship is flexible in response to requests for a change, the relationship helps them functioning better. However, when it comes to real performance, i.e. increased service to pregnant women, increased quality of work, lower costs, midwives are more positive about it then obstetricians. Fourthly, although all parties expect the relationship to last a long time, and that it resembles a strong marriage, the relationship cannot be called symmetric. Midwives feel stronger than obstetricians that it is a shared responsibility to make sure that the relationships work and to treat problems. In addition, midwives feel they depend strongly on obstetricians, whereas obstetricians do not feel they depend on midwives.

6.4 Findings 2: What are the Dynamics in Inter-Organizational Collaboration?

This section presents the findings regarding the second research question: What are the inter-organizational dynamics in perinatal care? This is investigated by interviews and group model building sessions.

The interviews focused on topics concerning the collaboration between obstetricians and midwives. What contributes to good collaboration? What are the causes of bad collaboration? And how does one notice it is getting better or worse? Briefly, meeting each other often, having a shared vision on perinatal care, and being familiar with each other's standards, tasks and competences, contributes to good collaboration. On the contrary, changes in staff, differences in power, bad communication, promises which are not being kept, and the fear of 'stealing each other's clients' do not contribute to good collaboration. The performance of the collaboration comes to the surface among others in the number of conflicts, the number of irritations, the frequency of consultations and the evaluation of pregnant women.

In the group model building sessions, a total of eight causal loop diagrams were designed. They are presented in Appendix C. This section presents different topics that are mentioned both in the interviews and in the group model building sessions. Key insights are stressed in boxes.

Collaboration and competition between midwives and obstetricians

Regarding collaboration and competition between midwives and obstetricians, the interviews show the following. Midwives have a fear of obstetricians trying to "steal" their pregnant women. Midwives have the feeling that obstetricians want to take care for as many pregnant women as possible, regardless of their risk level, because it will provide them with a higher income. However, as the obstetricians argue, midwives do not realize that the obstetricians do not have a financial incentive to care for more pregnant women. They receive a certain amount of money for the whole year, regardless of the number of women they have actually cared for. Still, midwives are confronted with the fact that pregnant women with a low-risk pregnancy are being cared for in the hospital. Pregnant women who present themselves to the hospital when they notice they are pregnant are not always referred to primary care (even though the obstetrician might try), or pregnant women who have an obstetric consultation in the hospital due to an increased risk are not send back to primary care when the risk is low again. Midwives notice these low-risk pregnant women who are taken care for in secondary care due to the fact that they are responsible for them during post partum care. On the other hand, obstetricians are afraid of

midwives not referring high-risk pregnant women in time to the hospital due to not recognizing a higher risk.

Midwives are afraid of obstetricians stealing their pregnant women. Obstetricians are afraid of midwives lacking competences to recognize high-risk pregnancies.

It is expected that better collaboration results in a higher quality of care. More collaboration will result in sharing services and in being able to make better agreements with each other. In addition, it is expected that better collaboration between obstetricians and midwives results in more consistency in regional policy, which in turn results in clarity for all professionals involved in who is doing what during the care process and at what time. This results in fewer irritations between professionals and in fewer mistakes. Also, better collaboration results in trusting each other more and in fewer delays in asking for obstetric consultations and in referring pregnant women to each other (especially from midwife to obstetrician).

Collaboration increases the quality of care delivered by all organizations.

More and successful collaboration will result in even more collaboration. More collaboration will result in fewer irritations and in seeing each other formally and informally, to knowing each other better, to respecting each other more. This all contributes to more trust and collaboration in the longer run.

Successful collaboration results in more trust and in more collaboration.

One midwifery practice has some privileges from a hospital, which other midwifery practices do not have. They even want to take the collaboration to a next level. However, until now this has not happened. Increasing the collaboration between one midwifery practice and the obstetric department in a hospital messes up the relation with other professionals in the region. For example, midwifery practices agreed to establish a regional primary care echo center, so midwifery practices would not have to conduct echo's in their own practice. Due to levels of distrust arrangements which involve all midwifery practices are hard to realize.

Midwifery practices are jealous on those midwifery practices who receive privileges from obstetric departments in hospitals.

Collaboration and competition between midwifery practices

Good collaboration between midwifery practices is important for the region; it contributes to regional policy, and it helps midwives action against the obstetricians as one professional group. Regarding the level of collaboration and competition between midwifery practices,

the midwifery practices always have had an informal agreement that they would not try to do business in each other's work territory. As a result there were hardly any feelings of competition. However, in the last years, three things made this situation change. Firstly, a new midwifery practice was founded that got some privileges from one of the hospitals. Secondly, a large new residential area has been built. The midwifery practices agreed that this new market would be equally divided between the midwifery practices. However, reality is different; some midwifery practices are more aggressive in entering the area than others. And thirdly, the number of pregnant women decreases, and as such the financial position of midwifery practices decreases. There still is collaboration between midwifery practices, for example when developing regional protocols and being on call for each other during nights and holidays, but the atmosphere has definitely changed. As a result there is a desire to collaborate more with hospitals. It is expected that hospitals will refer low-risk pregnant women to those midwifery practices that they have a good collaboration with.

Midwifery practices have to collaborate to act as one against the obstetricians, but they are also each other's competitors.

Financial pressure on midwifery practices increases the willingness to collaborate but also increases feelings of competition.

The higher the collaboration between midwifery practices and hospitals, the more low-risk pregnant women will be referred from the hospitals to midwifery practices.

Collaboration between obstetric departments in hospitals

Regarding the obstetric departments in hospitals, competition between those departments has a negative effect on their collaboration. As a result, a hospital might be more willing to give privileges to certain midwifery practices, which affects the collaboration between midwifery practices, as described above.

The quality of collaboration between the obstetric departments in hospitals affects the collaboration between midwifery practices and hospitals.

Shared protocols and guidelines

There are national guidelines on risk and referral criteria for deciding if a pregnant woman should be taken care of in a midwifery practice or in an obstetric department in a hospital. In addition, the two interest groups, KNOV (midwives) and NVOG (obstetricians), have national guidelines on how to deal with certain situations. These national guidelines often need to be detailed out locally. With twelve midwifery practices and two hospitals in Tilburg, it is not necessarily the case that each organization does this in the same manner. There are meetings between obstetricians and midwives in Tilburg regarding shared protocols. However, there are many topics that should be in protocols but which are not.

In 1997-2000 about seventy protocols are developed. About 1/3 of them needs to be updated, but in the last three years only nine protocols were updated. Designing and updating protocols takes a long time because each professional group has to be consulted, because there are difference in opinions on how to provide care to pregnant women, and because some organizations do not evaluate new protocols on the contribution to the quality of care, but on the impact on their own business (financially). In addition, the scope of a protocol is sometimes hard to define: it has to be wide enough to encompass enough pregnant women, and small enough to actually provide the professional with some guidelines.

Due to the lack of speed in updating protocols and developing new ones, the question arises if working according to protocols is the right way, or if one needs to work in a different way. Instead of having protocols, it might be better to have personal contact between the professional groups, to exchange information personally, and to better collaborate.

Better collaboration might result in fewer protocols.

Using shared protocols results in clearness about who should do what in a certain situation and increases the knowledge of the professionals. This guarantees continuity of care and a high quality of communication towards the client (otherwise different professionals will provide the client with different information regarding the care pathway). This also results in a higher client satisfaction, which makes them come back to the same care provider next time, which makes it easier for the professional to help the client next time. In addition, clearness in who should do what in a certain situation results in a better work atmosphere and thus in higher job satisfaction. Professionals will less likely switch employers which results in having a stable work force.

Shared protocols result in a higher quality of care.

Shared protocols result in a higher client satisfaction.

Shared protocols result in a higher staff satisfaction.

The usage of shared protocols depends on whether they are up to date and whether one expects the other professionals to use them also. If midwives do not expect obstetricians to act accordingly, why should they act accordingly? And vice versa. According to obstetricians, midwives sometimes do not want to work according to a protocol which is not evidence-based and they do not realize that working in different ways in the region might be more harmful than working according to a non-evidence based protocol.

Having non-up-to date protocols results in professionals not using them.

Working according to a non-evidence based protocol might be less harmful in the end than working according to no protocol at all.

The obstetric departments in the two hospitals have about ten protocols which are the same; the other protocols vary per hospital. In addition, the obstetric department of one of the hospitals adheres to a special, in the Netherlands somewhat controversial, philosophy: preventive support of labor (Reuwer, Bruinse, and Franx, 2009). Some midwifery practices question the research that this philosophy is based on. In addition, they do not like the fact that this philosophy is developed by two male obstetricians: no females and no midwives were involved. For midwives it is confusing that the obstetric department of one hospital is working according to this philosophy and the other one is not, and it is confusing that not all protocols are the same for the two. This way midwives have difficulty providing the right information to pregnant women who will deliver in different hospitals.

Obstetric departments having different protocols results in confusion for midwifery practices that have to provide information to pregnant women.

Residents

Residents in the hospital are doing consultations and are present in the delivery rooms. Residents work more or less autonomous together with nurses, obstetricians only intervene when necessary. Midwives often (about 90% of the time) face residents when interacting with the obstetric department in the hospital, for example when referring a client during labor. Contact with residents is limited to a specific pregnant woman, whereas contact with obstetricians is often more policy related.

Midwives have the perception that residents do not have much respect for them, that residents are not open to feedback, and that residents do not know what the competences of midwives are. Residents often only stay a year and they do not attend informal and formal meetings, which makes it harder for midwives and residents to get to know each other. This results in low levels of trust of midwives in residents and thus in less consistency in policy, in delays in interventions and thus in a lower quality of care.

Knowing each other results in trusting each other and that has a positive effect on the quality of care.

The trust that midwives have in residents is determined by the following. Firstly, by the competences of the nursing staff in the delivery room and by the instructions they provide the residents with. Secondly, trust is determined by the perception the midwives have of the residents' competences. It seems that the younger ones need more and more supervision and that the level of education is lower than it used to be. Thirdly, the relationship between obstetricians and residents is of importance. If residents are left unsupervised, they will be working too independently. According to midwives, the supervision of residents varies

greatly per obstetrician. Midwives have the impression that residents are “afraid” of some obstetricians and that they therefore wait too long to contact them in case of complications. Fourthly, the more trust midwives have in residents, the better midwives comply with guidelines set by the obstetric departments, and as a result, the more residents will trust midwives and the better residents will comply with the guidelines set by the hospital.

Collaboration between professionals in the obstetric department (supervision of residents) has an effect on collaboration between professionals in the obstetric department with professionals of the midwifery practice (residents and midwives).

The higher the perceived competences of the other (both individual as well as team performance), the more one trusts the other.

The more one trusts the other, the more one is willing to comply with policies and guidelines, which results in higher levels of trust.

In the plenary sessions obstetricians have acknowledged the fact that residents are often left alone to work. However, midwives should also have to realize that when a resident does not work according to local policy, it does not necessary imply that they act medically irresponsible. These residents sometimes come from a different hospital where different procedures were in place. And indeed, it can be annoying for the client that she receives different information from different professionals due to this.

6.5 Findings 3: Are there (Preliminary) Guidelines on how to Improve Perinatal Care?

This section presents the findings regarding the third research question: Are there preliminary guidelines on how to improve perinatal care? Improvements are being formulated in three phases, where a previous phase feeds the new phase (Figure 6-5). Firstly, preliminary guidelines on how to improve perinatal care were formulated in the interviews. Secondly, these are further detailed out in more concrete improvement proposals in phase B. Thirdly, improvements are actually being implemented by task forces in phase C. All the defined improvements are the result of interaction with the professionals in the case study; no explicit literature review is done. The improvement proposals are described in more detail in Appendix D. It is not that the different phases work as a funnel. In each of the phases improvements are defined, some previous ones are further developed, some are rejected and others are newly defined.

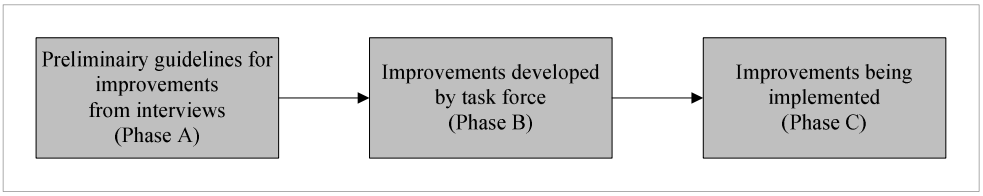

Figure 6-5 Defining improvements

Preliminary guidelines from the interviews

In the interviews (Phase A), suggestions for improvement are mentioned. Regarding the exchange of information, one would like to see the following improvements. Firstly, midwives would like obstetricians to provide better information to them in case a mother has spend a couple of days in the hospital during the postpartum phase, because when the client is send home, the mid wife is responsible. Secondly, midwives would like to receive better information after a pregnant woman has had an obstetric consultation in the hospital. Pregnant women have to take the information back to the midwife by themselves. Sometimes they do not remember exactly what the obstetrician has said and sometimes the obstetrician only says "that the midwife has to check more often". It is not known then what specifically to do. Thirdly, one would like to discuss pregnant women more often, discuss what to do with a woman when she is referred, especially during labor and when the woman needs an operation. Finally, pediatrics can provide better information to midwives regarding newborns that are referred to the hospital during the postpartum phase.

Regarding the care process itself one sees the following improvements. Firstly, midwives could be given more responsibilities. More women are being taken care of by the obstetrician due to an increased risk (for example because a previous cesarean section). However, a lot of the tasks can be performed by midwives. By extending their responsibilities (still under the supervision of an obstetricians because midwives are officially not yet allowed to have these responsibilities) the obstetrician's workload will be decreased. Secondly, services could be shared, for example, every midwifery practice has its own information meetings for pregnant women. This takes a lot of time and sometimes only a few women show up. It might be much more effective to arrange these information meetings together among midwifery practices and hospitals. Thirdly, about 80% of the pregnancies are standard. It should be possible to design a service for those 80% in which each professional exactly know who does what. This way there should be enough time to really communicate in person about the other 20%.

The way in which one can contact each other should be improved, for example by stimulating professionals to attend formal and informal meetings, by having a contact person in the other organization who is available for discussing all kinds of issues, and by

having an integrated care coordinator who is responsible for overseeing the whole region and who helps communication between different providers.

In addition, midwifery practices and hospitals should have their clients take the same questionnaire regarding quality of care. That way it might be easier to compare care processes and to learn from each other.

One concern with the improvements which imply scaling things up is that the personal attention that midwives from midwifery practices can give to pregnant women will be lost.

Improving exchange of information.
Streamlining care processes (more efficient use of resource, smoother care pathway for pregnant women).
Getting to know each other better, both personally as well as professionally.

Preliminary guidelines developed by the task force

In phase B of this project, improvement proposals are defined by obstetricians and midwives. The ideal situation, according to the developers of the improvement proposals, is one which midwives from midwifery practices and obstetricians work as much as possible together in order to be able to deliver the highest quality of care. In total, twelve improvements are defined (see Appendix E for detailed information): Joint intake (1), prenatal diagnostics (2), echo diagnostics (3), joint discussion on pregnant women (4), electronic medical record (5), provision of information to pregnant women (6), shared education (7), consultation rooms for midwives in the hospital (8), on call system (9), reception of women in labor in the hospital (10), referral while in partu (11), overnight stay in hospital (12). Some of the improvement proposals have multiple levels of required collaboration, with the one with the highest level of collaboration corresponding to integrated care.

Improvements being implemented

In phase C a selection of 8 is being implemented. Table 6-2 present the improvements and their relation with the field of improvement as described above (exchange of information, streamlining care processes, getting to know each other better). Interestingly, whenever an improvement could be executed at different levels of collaboration, both midwives and obstetricians choose for the highest level of collaboration.

Table 6-2 Relation between teams and field of improvement

	Improve exchange of information	Streamlining care processes	Getting to know each other better
Development of electronic patient record	x	x	
Joint educational program		x	x
Weekly discussion of pregnant women	x	x	x
Prenatal screening	x	x	
Preconceptual consultations	x	x	
Suspicion of abuse	x	x	
Uniform information material for pregnant women	x	x	
Pediatrics	x	x	x

6.6 Summary, Limitations, and Concluding Remarks

6.6.1 Summary

The interviews, the causal loop diagrams, the discussions in the plenary session, the researcher's experiences as a project manager, they all stress that trust and knowing each other are prerequisites for collaboration. Not only have the dynamics between organizations (between midwifery practices, between hospitals, and between midwifery practices and hospitals) an effect on overall collaboration in the region, also the dynamics within an organization (especially within hospitals) have an effect. The professionals expect that collaboration in the region (exchange of information, streamlined care processes, and knowing each other better, both professionally as well as personally) results in higher quality of care, in higher satisfaction of pregnant women and in higher professional satisfaction. The improvements all contribute to these three topics; they are all expected to result in higher collaboration, they are expected to make the perinatal care system a more integrated one. However, during the implementation, no changes to the current inter-organizational design (that of two hospitals and twelve midwifery practices) are made.

6.6.2 Limitations

One limitation might be that this research focuses on the main professionals, midwives and obstetricians, only. Residents do a substantial part of the work in hospitals (as is shown in Chapter 5), and they are often the ones that have contact with midwives, especially when midwives refer pregnant women during labor to the hospital. Residents were not involved in this research for the following reasons. Firstly, residents come and go on a regular basis, their aim and focus is on learning how to become a good obstetrician, and their work pressure is high (Arbeidsinspectie, 2008; Fletcher et al., 2005). As such they do not have

much time and interest in actively building local relations with midwives from midwifery practices. Secondly, the more structural work in the obstetric department is done by obstetricians. They are responsible for the development of protocols and procedures, on deciding how to collaborate with external parties as midwifery practices. In addition, it is their task to be an example for residents in how to collaborate with midwives. It is part of the "informal" or "hidden" curriculum of residents (Karnieli-Miller et al., 2010; Witman, 2007). As such, we felt that it was legitimate to only involve and focus on midwives and obstetricians.

A second limitation might be that there are regional differences in outcomes in the questionnaire regarding the collaboration between midwifery practices and the obstetric departments in the north and in the south region. This research did not dig deeper in the causes. Would it be caused by different cultures in the obstetric departments? Would it be caused by the fact that in the north hospital the obstetricians are employed by the hospital, whereas in the south hospital the obstetricians own their own corporation, within the hospital? Or would something else cause this difference?

6.6.3 Concluding Remarks

Although we know from the literature (see Section 2.6) what contributes to good and to bad collaboration, the in-depth case study is conducted to gain a deep understanding of collaboration and the inter-organizational dynamics in this specific setting: perinatal care in the Netherlands. What this research found is that trust, knowing each other and feelings of competition are important aspects of inter-organizational collaboration. Even when there are formal rules on how to work together, when trust is lacking, when there are feelings of competition, collaboration is lagging.

Different aspects define trust. The questionnaires focused on aspects as having personal confidence in one another, in having business confidence in one another, in whether or not the other keeps its promises, whether to believe the information the other is providing, and whether or not the other is genuinely concerned that the business will succeed (see Appendix A). The interviews and group model building sessions especially showed that midwives do not believe that the obstetricians are genuinely concerned that their business will succeed for as obstetricians hold on to low-risk pregnant women. As such, midwifery practices lose business. Also, the obstetricians have doubts regarding the business or professional confidence in the other, since midwives often either do not recognize a high-risk pregnancy, or wait too long with referring high-risk pregnant women to the obstetrician.

The improvements that are defined and being implemented all focus on maintaining the current organizational boundaries, but at the same time intensifying collaboration between

the organizations. One could state that the Tilburg region is moving towards a collaborative model of delivering perinatal care. In the last years, in addition to the model where collaboration is intensified (the improved collaboration model), two more types of improvements in the Dutch perinatal care system can be found. Firstly, more and more hospitals employ specialized midwives, in order to meet the *care* needs of pregnant women better (improved hospital model). Secondly, some hospitals have integrated with one or more midwifery practices (integrated care model). The next chapter will focus on these three models of improvements (more collaboration, improved hospital, integrated care), on how these improvements are expected to result in better (or worse?) outcomes and on which design might work best for Dutch perinatal care.

Chapter 7.

Evaluating Inter-Organizational Designs in Dutch Perinatal Care

This chapter is based on

Pieters, A., Van Oorschot, K., Akkermans, H., & Brailsford, S. (2013). Care & Cure: Combine or Collaborate? Evaluating Inter-Organizational Designs in Healthcare. *Proceedings Academy of Management Annual Meeting*. Orlando, United States.

Pieters, A., Van Oorschot, K., & Akkermans, H. (2012). Care & Cure Combined: Using Simulation to Develop Organization Design Theory for Health Care Processes. *Proceedings International System Dynamics Conference*, St Gallen, Switzerland.

7.1 Introduction

In the previous two chapters it is shown that the current design of Dutch perinatal care, that of a system in line with the principles of the focused factory concept, where a split is made based on the characteristics of pregnant women (low-risk versus high-risk), is not working well due to, amongst others, organizational inertia and stickiness (see Chapter 5). Inter-organizational dynamics regarding collaboration, trust and competition play a major role in this (see Chapter 6). A solution might be found in a different design. This chapter focused on the third research question:

RQ 3. What inter-organizational design would work best for Dutch perinatal care?

Three different designs are found in practice and they all focus on putting the needs of pregnant women first, on meeting both their *care* and *cure* needs. With the help of a system dynamics model these designs will be evaluated. Section 7.2 presents the research method. Section 7.3 describes three generic designs. Section 7.4 describes the structure, the feedback loops and the variables of the model in detail. The results of the scenarios are presented in Section 7.5. Concluding remarks are made in Section 7.6.

7.2 Research Method

System dynamics (SD) is used as the method of modeling (see also Section 3.7). The system dynamics model is based on different sources of data: mental, written and numerical data (Forrester, 1980). Firstly, mental models regarding collaboration between midwifery practices and obstetric departments in hospitals have been elicited through questionnaires, interviews and group model building sessions; sixteen obstetricians from two hospitals and forty-five midwives from twelve midwifery practices were involved (see Chapter 6). Secondly, mental and written data have been obtained by observation, interviews, and clinical action research (see Chapter 6). Thirdly, numerical data about flows of pregnant women between a midwifery practice and a hospital have been analyzed (see Chapter 5). In addition, causal loop diagrams and a preliminary system dynamics model have been developed with two obstetricians, one from each hospital. Finally, literature regarding the Dutch perinatal care system and collaboration has been studied.

Even though many different disciplines are involved in delivering perinatal care to pregnant women, such as midwives, obstetricians, residents, general, obstetric and maternity nurses, pediatricians, ultra sound scan specialists, and others, this research focused on obstetricians and midwives, for as they are overall responsible for the care process.

7.3 Generic Inter-Organizational Designs

One apparent solution to the problems with the current design is to make major steps towards a more integrated system (see Chapter 5). Currently, different designs pop up in practice. For the purpose of our analysis, we group the variety of those designs into three generic models. All these three designs start from the perspective of putting the needs of pregnant women first, of trying to make sure that both the *care* and *cure* needs of pregnant women are met. The scenarios are discussed in more detail below.

Collaborative Model

The collaborative model focuses on improving the collaboration between midwifery practices and obstetric departments. Examples of improvements in collaboration are the following. On a national level, the risk and referral criteria are improved by the professional associations of the midwives and the obstetricians (Amelink-Verburg and Buitendijk, 2010), so it becomes more clear who should be caring for which pregnant women. On a regional level, the collaboration in Obstetric Co-operative Groups or maternity care collaboratives can be improved (Advies Stuurgroep Zwangerschap en Geboorte, 2009; Boesveld-Haitjema et al., 2008; Veer and Meijer, 1996). The objective of these types of groups is to define policy at a regional level, to discuss specific problems, and to find solutions together. One can intensify the collaboration between midwifery practices and hospitals even further by partly integrating some aspects of the care process and by sharing and developing knowledge (see Chapter 6). Regarding the provision of information, shared electronic health records can be developed so that information of pregnant women is always available for anyone who needs to (currently, midwifery practices and hospitals each have their own information system).

Improved Hospital Model

In the improved hospital model highly educated so-called clinical midwives are employed by the hospital. At first, the reasons for their employment were staff shortages in labor wards and a growing preference among midwives for a salaried position with regular work hours. Later, it was recognized that these midwives would improve the quality of care because they are specialists in physiological care; they have specific knowledge of the physiology of pregnancy and giving birth (Wiegels and Hukkelhoven, 2010). This model is very popular at the moment; in the last ten years, the number of hospitals that employ clinical midwives has increased from 40 to 80 (out of about 110 hospitals) and the number of clinical midwives has increased from 240 to 640 (Hingstman, Kenens and Wiegers, 2011).

Integrated Care Model

In the integrated care model some midwifery practices and obstetric departments in hospitals merge into one organization. Or, as the Dutch author Meuwissen proposed back in 1979: "Create obstetric centers where midwives, obstetricians, GP's, pediatricians work together. Care can be provided both in the hospital and on location, but the focus is on professionals collaborating in order to provide the care that the women and her child need" (Meuwissen, 1979). These obstetric centers never have been put into practice. Currently, there are some initiatives where one or two midwifery practices in a region integrate with an obstetric department in a hospital. As such, an integration percentage of 20% is chosen: the 20% integrated care model. This implies that 80% of the midwifery practices remain independent from the hospitals.

7.4 Model Description

The model's aim is to provide insight in the inter-organizational designs, the accompanying dynamics in inter-organizational collaboration and the effect on patient flows in the system and thus on patient's wellbeing and health. As such, this research takes an organizational perspective on patient flows and referrals between organizations (Provan, 1984). This section presents the main structure of the model, the main assumptions (A1-A7), and the main feedback loops (R1 and R2).

High Level Stock and Flow Diagram

The main ingredients of SD models are stocks and flows. In the diagramming notation, stocks, represented by rectangles, denote a particular level of a variable (e.g. the number of pregnant women), flow variables fill or drain the stock and are depicted as pipes with valves. The clouds represent infinite sources or outcomes of particular flows that are beyond the scope of the model. The arrows indicate causal relationships. The + signs at the arrowheads indicate that the effect is positively related to the cause, the - signs that the effect is negatively related to the cause (Sterman, 2000).

A high level stock and flow diagram of the SD model is presented in Figure 7-1. The four stocks represent where pregnant women are in the system. This depends on their risk level (low-risk or high-risk) and on which organization is taking care of them (midwifery practice or obstetric department in a hospital). It is assumed that all pregnant women will deliver a child and that there are no miscarriages.

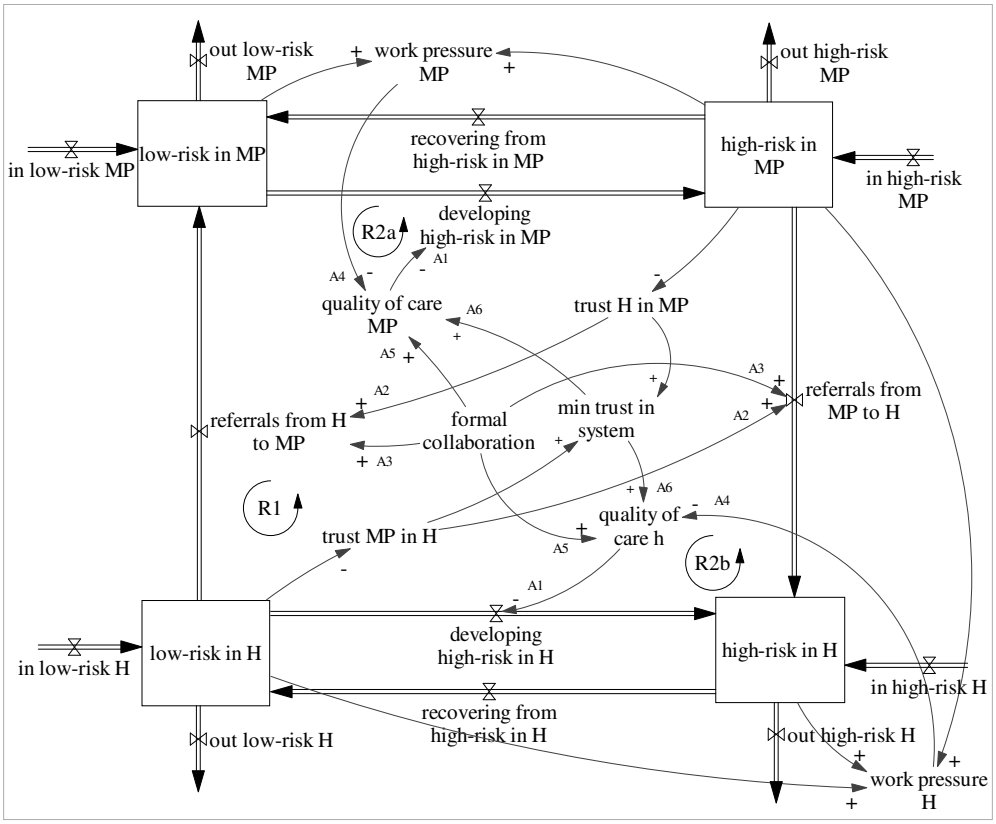

Figure 7-1 High level stock and flow diagram

Within an organization, pregnant women "flow" from one stock to another by developing and recovering from a high-risk pregnancy, which is affected by the quality of care the organization is delivering (A1). Due to the nature of being pregnant, a certain percentage of pregnant women will always develop a high-risk pregnancy, regardless of the quality of care. Whether or not pregnant women are referred between midwifery practices and hospitals depends on the level of trust and on the level of collaboration (A2 and A3).

Trust

The referral behavior between the midwifery practices and hospitals is determined by the level of trust between obstetricians and midwives. Trust is defined as the confidence in the good will of the others in a given group and belief that the others will make efforts consistent with the group's goals (Ring and Van de Ven, 1994). Although trust consists of several aspects (Nooteboom, 2004), the interviews and group model building sessions (Section 6.4) show that trust that midwifery practices have in hospitals seems to be determined by financial incentives, by fear of hospitals stealing their clients. On the other

hand, trust that hospitals have in midwifery practices seems to be determined by the obstetricians' perceptions of the competences of midwives regarding recognizing high-risk pregnancies.

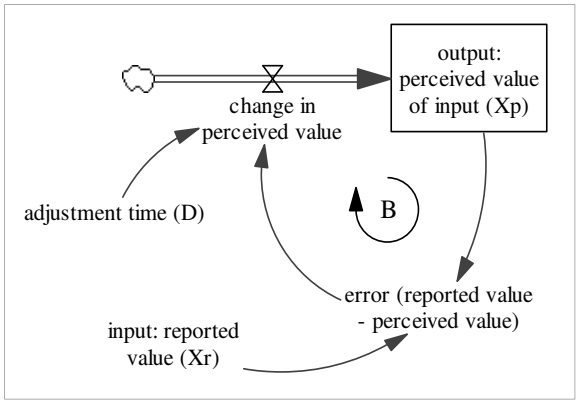

Figure 7-2 Modeling structure for adaptive expectations

Trust is modeled as a stock with the feedback structure of adaptive expectations (Figure 7-2) (Sterman, 2000). Trust and referral behavior are tied together in a self-reinforcing feedback loop (R1), the trust-loop (see Figure 7-3). The more low-risk pregnant women are being cared for in hospitals, the less trust midwifery practices have in hospitals, the less high-risk pregnant women midwifery practices refer to hospitals, the higher the number of high-risk pregnant women in midwifery practices and the less trust hospitals have in midwifery practices. As a result, hospitals refer less low-risk pregnant women to midwifery practices, which results in a higher number of low-risk pregnant women in hospitals.

It is assumed that there is complete transparency of who is taking care of which type of pregnant women (low- or high-risk). Midwives have insight into the number of low-risk pregnant women hospitals take care of because midwives are responsible for the aftercare of pregnant women, not only for the pregnant women that have been taken care of in the midwifery practice, but also for those that have been taken care of in the hospital. Obstetricians have insight into the number of high-risk pregnant women midwifery practices take care of because these women often have to be referred to the hospital due to complications during delivery.

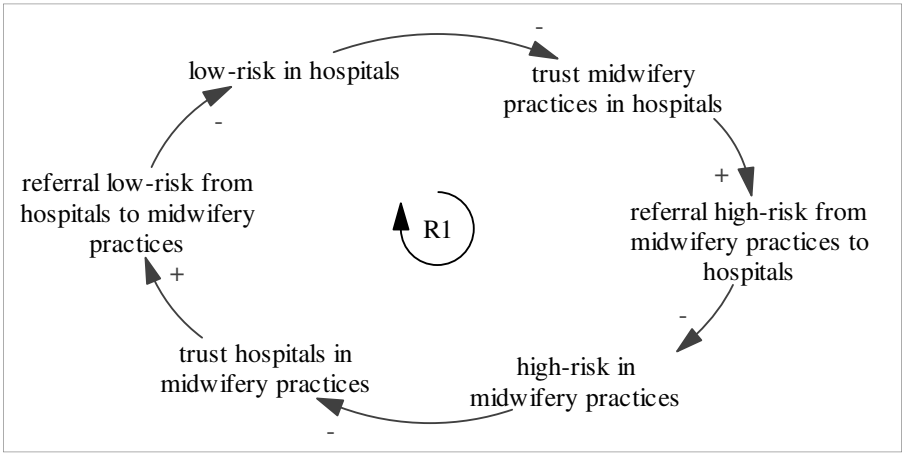

Figure 7-3 Trust loop

Collaboration

The referral behavior between the midwifery practices and the hospitals is also determined by the level of collaboration. Collaboration in the model refers to formal collaboration. It is characterized by contractual obligations and formal structures of control. These formal types of cooperation can evolve over time into informal types in which rules and regulations are no longer needed (Smith, Carroll and Ashford, 1995; Wren, 1961).

Formal collaboration is modeled as an exogenous variable. It represents a level of collaboration that the midwifery practices and the hospitals have agreed upon together, in rules, protocols, procedures and guidelines, or just in intentions (see the results from the interviews and group model building sessions in Section 6.4). These procedures and guidelines are partly dictated by national regulations (College voor Zorgverzekeringen, 2003), but are also developed locally. In practice, most of this formal collaboration is voluntarily; there are no checks on whether or not organizations comply with the agreements made, and there are hardly any sanctions when organizations do not comply.

Actual Collaboration: Combining Formal Collaboration and Trust

Formal collaboration and trust both can have an effect on other variables, such as referral behavior and quality of care. Formal collaboration, trust and the degree to which the formal collaboration is voluntary come together in something that we call “actual collaboration” (see also Appendix F). The more voluntary the formal collaboration is, the more the actual collaboration depends on the level of trust. Even so, the more mandatory the formal collaboration is, the less the actual collaboration depends on trust. Or in other words, the more one trusts the other, the more one is willing to comply with policies and guidelines,

which results in higher levels of trust (see the results from the interviews and group model building sessions in Section 6.4).

Quality of Care

The flow of pregnant women within an organization is determined by the delivered quality of care of hospitals and midwifery practices. The delivered quality of care is determined by the perceived work pressure (A4) (Oliva and Sterman, 2001), the actual collaboration (A5 en A6) (see the results from the interviews and group model building sessions in Section 6.4), and the maximum quality of care that can be delivered. The maximum quality of care depends on the competences of midwives and obstetricians. Midwives lack *cure* competences (Van Dillen et al., 2011; Bonsel et al., 2010; Amelink-Verburg and Buitendijk, 2010; Reuwer, Bruinse and Franx, 2009) and obstetricians often lack *care* competences (Franx, 2011; NVOG-HOOG, 2005). Actual collaboration can improve the competence in each organization because of learning from each other (see improvement proposals in Section 6.5). The delivered quality of care of hospitals and midwifery practices is modeled as a stock with the feedback structure of adaptive expectations (also called a first-order information delay) (Figure 7-2) (Sterman, 2000).

Work Pressure

The perceived work pressure is modeled as a stock with the feedback structure of adaptive expectations (Figure 7-2) (Sterman, 2000). The perceived work pressure is determined by the number of consultations pregnant women demand of an organization. Capacity is expressed in the number of consultations that can be conducted, and is adjusted to the perceived work pressure. Perceived work pressure and the delivered quality of care are tight together in the self-reinforcing feedback loop (R2), the work-pressure-loop (Figure 7-4). The higher the work pressure, the lower the delivered quality of care, the more high-risk pregnant women, the more consultations and the higher the work pressure.

Model Documentation

The model documentation is provided in Appendix F. The following topics are included in the documentation: the abbreviations used, additional details on the structure of certain parts of the model, various modeling considerations, an assessment of the model according to the standards of the System Dynamics Review (Martinez-Moyano, 2012), a summary of the sensitivity analyses conducted, and a documentation of the variables in the model according to the standards of the System Dynamics Review (Martinez-Moyano, 2012). The model is available upon request.

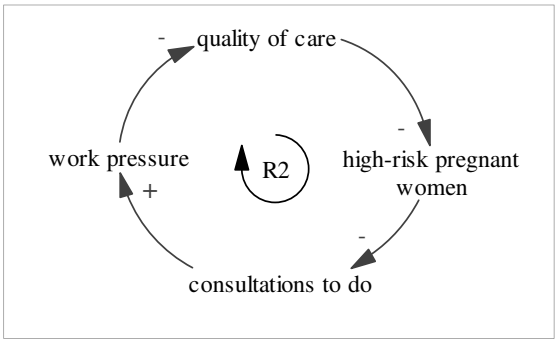

Figure 7-5 Work pressure loop

7.5 Performance Indicators

The regular performance indicators that are used in Dutch perinatal care, such as the number of caesarean sections and the Apgar score, are described in Section 4.4. The model, however, is an abstract representation of reality. It does not represent everything that is being done in perinatal care, such as the interventions, the tests conducted, the demographics of the pregnant women, etcetera. Modeling all these details is too detailed for the purpose of the model: investigating what the effect of different inter-organizational designs and the dynamics of formal collaboration and trust are on the performance of the system. As such, the SD model uses different performance indicators, which reside in the field of operations management and service marketing.

The first performance indicator concerns medical performance. In healthcare, performance can be measured by survival or death rates, as is for example often done in intensive care units (Dey, Hariharan and Clegg, 2006) and in perinatal care (EURO-PERISTAT, 2008). However, since maternal and perinatal death rates in perinatal care are relatively low, the effect of changes in the delivery of care on these rates is hard to measure (Van Dillen et al., 2011). Therefore the *total percentage of high-risk pregnant women* is chosen as the performance indicator regarding medical performance. These women are defined as high-risk because they are expected to have a higher risk of complications (perinatal morbidity and mortality and maternal morbidity and mortality).

Secondly, two of the main principles in the field of operations management are “doing the right things” (effectiviness) and “doing these things right the first time” (efficiency) (Heskett and Schlesinger, 1994). Applying these principles to the healthcare sector suggests two things. One does not do the right things right the first time if a) the needs of patients are not met, and b) if patients are taken care of in the wrong organization. Regarding the first,

pregnant women do need both *care* and *cure*. Midwifery practices lack in meeting the *cure* needs, obstetric departments in hospitals lack in meeting the *care* needs. As such, one might claim that the current care process that pregnant women go through is not done right since their needs are not met. The accompanying performance indicators are *the delivered quality of care in the hospital* and *in the midwifery practice*. Regarding the second, the number of pregnant women that are taken care of in the wrong organization is represented by the number of low-risk pregnant women in the hospital and the number of high-risk pregnant women in the midwifery practice. However, the severity differs for the two populations. The stakes are especially high for high-risk pregnant women that are being taken care of in midwifery practices (Van Dillen et al., 2011). As such, one would strive for 100% of the *high-risk pregnant women to be taken care of in the obstetric department in the hospital*. Therefore, the latter is chosen as the performance indicator for effectiveness.

Thirdly, in the service operations management and service marketing literature, customer expectations, customer satisfaction and perceived service quality are of major importance (Heskett and Schlesinger, 1994; Zeithalm and Berry, 1993; Parasuraman, Zeithalm and Berry, 1985), and they depend on the quality of the services that organizations deliver. These services depend on which organizations perceive the customer needs and how organizations translate these perceived needs to actual services (Parasuraman, Zeithalm and Berry, 1985). This brings us to the third performance indicator: the satisfaction of pregnant women, which is expressed by the degree to which the *care* and *cure* needs are met by the organizations. This is expressed by respectively the *delivered quality of care of midwifery practices* and the *delivered quality of care of hospitals*. In addition, the *percentage of high-risk pregnant women that is taken care of in midwifery practices* is a representative of the satisfaction of pregnant women, due to dissatisfaction when being referred from home to hospital during delivery (Rijnders et al., 2008; Christiaens, Gouwy and Bracke, 2007). The latter is basically the same as "100-percentage of high-risk pregnant women in the hospital" (since the two percentages together add up to 100%).

The final performance indicator is employee satisfaction (Goldstein, 2003; Heskett and Schlesinger, 1994). Since this research focuses on the inter-organizational dynamics, a factor on the inter-organizational level is chosen to represent employee satisfaction. One of the factors determining employee satisfaction is the inter-organizational level of trust (Dirks and Ferrin, 2001). Employee satisfaction in this model is thus measured by *trust midwifery practices have in hospitals* and by *trust hospitals have in midwifery practices.*

In summary, the following performance indicators are discerned: a) percentage high-risk pregnant women in the system (overall medical performance), b) percentage high-risk percentage pregnant women in the hospital (effectiveness), c) delivered quality of care in

midwifery practices and in hospitals (satisfaction of pregnant women), and d) trust midwifery practices have in hospitals and vice versa (employee satisfaction).

7.6 Simulations

The SD model is designed to investigate different inter-organizational designs for Dutch perinatal care. The model runs in weeks, for 10 years (520 weeks). The transition from the current situation to another inter-organizational design is introduced at t=10.

7.6.1 Generic Inter-Organizational Designs

The base case, the three generic inter-organizational designs and the changes that are made in the SD model at t=10 are presented in Table 7-1. The results for each of the performance indicators are presented below. Note that in scenario 4 (the integrated care model) the sharp decrease at t=10 is caused by the introduction of the new system and the sudden move of pregnant women and staff at t=10 from midwifery practices to hospitals. After this sudden move, the dynamics of the system take over and a new equilibrium is found.

Performance Generic Inter-Organizational designs

Medical performance is expressed as the percentage of high-risk pregnant women in the entire system (Figure 7-5). In all scenarios, this percentage decreases, which is obviously a desirable effect. In that sense, all models investigated are better than the base case of compartmentalization of *care* and *cure*. This performance improvement is mostly due to the following. Firstly, in the collaborative model (scenario 2), the quality of care that hospitals and midwifery practices deliver is increased, due to an increase in formal collaboration, which directly results in less low-risk pregnant women developing a high-risk pregnancy. Secondly, in the scenarios 3 and 4 either midwives are added to hospitals or midwifery practices integrate with hospitals. As a result, the maximum quality of care that hospitals or the integrated care organization can deliver is improved, and thus the delivered quality of care of that organization is improved also, which results in less low-risk pregnant women developing a high-risk pregnancy.

Effectiveness is expressed as the percentage of high-risk pregnant women in hospitals (Figure 7-6). Whether this percentage increases or decreases depends mostly on the levels of trust in the system, or, in other words, the perceived competition in the system. In the collaborative model (scenario 2), the trust-loop (R1) is positively enforced. In the scenarios 3 and 4 the added midwives in the hospitals will take care of the *care* needs of both low- and high-risk pregnant women, which makes the trust-loop (R1) turn into a vicious, rather than a virtuous cycle.

Table 7-1 Overview of the generic inter-organizational designs and the changes in the model

Design/ Scenario	Description of the scenario	Changes compared to base case (start at t=10)
1. Base case	Current way of working: midwifery practices take care of low-risk, hospitals of high-risk pregnant women	
2. Collaborative model	Improving the formal collaboration between midwifery practices and hospitals	1. Start collaboration project***.
3. Improved hospital model	Advanced/clinical midwives are employed by hospitals	1. Maximum quality of care in hospitals will increase to 1*. 2. The percentage of low-risk pregnant women that is referred from hospitals to the midwifery practices will decrease to 0**.
4. Integrated care model	A certain percentage of midwifery practices and the hospitals merge into one	1. 20% of all pregnant women that are being cared for in midwifery practices will be transferred to hospitals. 2. 20% of staff from midwifery practices will be transferred to hospitals. 3. The maximum quality of care in hospitals will increase to 1*. 4. The percentage of low-risk pregnant women that is being referred from hospitals to midwifery practices decreases to 0%**.
* When midwives are added to hospitals, the lack of *care* competences from the obstetricians will be compensated by the *care* competences from the added midwives. It is assumed that the new midwives and the obstetricians collaborate well and that they make sure that all pregnant women receive the right amount of *care* and *cure*.		
** There is no need to send these pregnant women to the midwifery practices, for as there are midwives in the hospitals who can perfectly take care of these low-risk pregnant women.		
*** A collaboration project has the following characteristics: the project takes 52 weeks and the goal of the new level of formal collaboration is 0.8 (out of 1) (the current level is 0.4). The degree to which the formal collaboration is voluntarily is 0.8 (out of 1).		

The satisfaction of pregnant women is expressed by the delivered quality of care of hospitals (Figure 7-7), by the delivered quality of care of midwifery practices (Figure 7-8), and by the percentage of high-risk pregnant women in the hospital (Figure 7-6). In the collaborative model (scenario 2), the trust-loop (R1) is positively enforced, resulting in increased levels of delivered quality of care in hospitals and midwifery practices, and in better referrals between organizations. As such, the percentage of high-risk pregnant women in hospitals increases. This scenario therefore has a positive effect on the satisfaction of pregnant women. However, in the scenarios where the quality of care in hospitals is improved by adding midwives (scenario 3 and 4), the result for the satisfaction of pregnant women is less positive. Indeed, the quality of care in hospitals increases, but the percentage of high-risk pregnant women in hospitals decreases, while at the same time those midwifery practices deliver slightly less quality of care, due to a decrease in trust that midwifery practices have in hospitals, since these hospitals refer less low-risk pregnant women to midwifery practices.

Employee satisfaction is expressed by the trust midwifery practices have in hospitals (Figure 7-9) and the trust hospitals have in midwifery practices (Figure 7-10). The only scenario where both are increased is scenario 2, the collaborative scenario. In the models where the quality of care in hospitals is increased by adding *care* competences (the core competence of midwives), trust that midwifery practices have in hospitals is damaged (scenario 3 and 4), since the trust-loop is turned into a vicious loop in these scenarios.

Conclusion Generic Inter-Organizational Designs

When comparing the order of the four designs, we have chosen to mainly focus on the effectiveness of the system, i.e. on the percentage of high-risk pregnant women that is being cared for in the hospital. We do not state that the other performance indicators are not important, but we do state that in terms of how well the structure of the system fits the condition (pregnancy), effectiveness is the main one. Note that medical performance is not chosen as the main performance indicator since in all scenarios medical performance increases, and since one could argue that having high-risk pregnant women taken care of in the wrong organization might actually be more harmful than having a little more high-risk pregnant women taken care of in the right organization, where they receive all the care that they need. As such, the analyses show that model 2, the collaborative model, is the only model that performs better than the base case. Model 3, the improved hospital model, and model 4, the 20% integrated care model, perform worse than the current design (Figure 7-7), due to virtuous circles of distrust and feelings of competition.

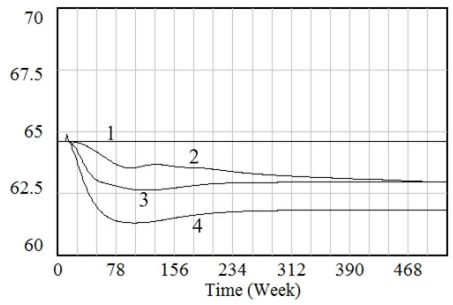

Figure 7-5 % High-risk women

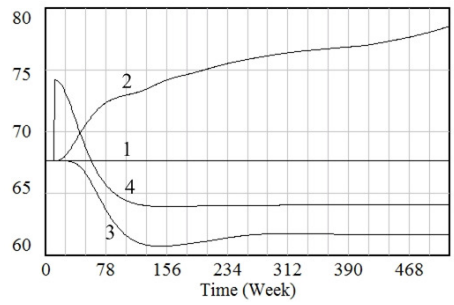

Figure 7-6 % High-risk women in hospitals

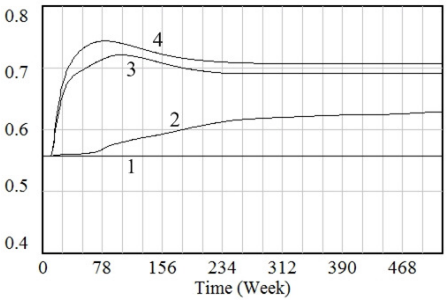

Figure 7-7 Delivered quality of care in hospitals

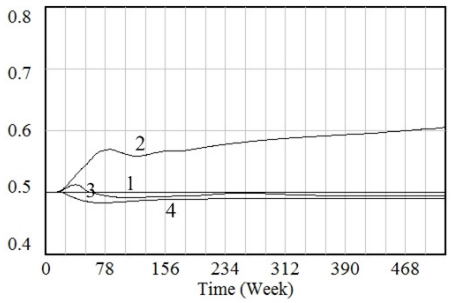

Figure 7-8 Delivered quality of care in midwifery practices

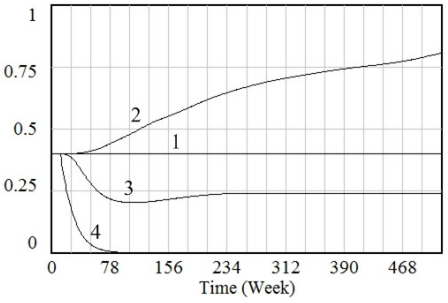

Figure 7-9 Trust midwifery practices have in hospitals

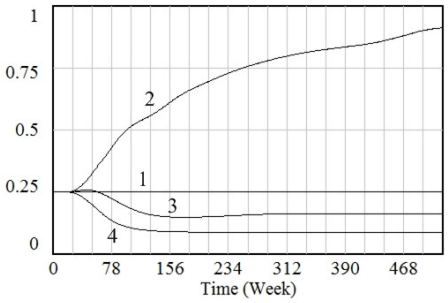

Figure 7-10 Trust hospitals have in midwifery practices

1. Base case
2. Collaborative model
3. Improved hospital model
4. 20% Integrated care model

7.6.2 Combined Inter-Organizational Designs

The analysis above shows that the collaborative model will result in better systems performance and that the other two designs, the improved hospital model and the 20% integrated care model, will result in a lower systems performance than the current design. Will these two models never work? What if these models each would be combined with the collaborative model? What if together with the implementation of these models the collaboration between hospitals and midwifery practices can be improved? In order to test this, two additional combined models are defined.

In the improved hospital + model (scenario 5), the improved hospital model and the collaborative model are combined. Thus, clinical midwives are added in hospitals, in order to improve the quality of care hospitals delivers, and at the same time the formal collaboration between hospitals and midwifery practices is intensified.

In the 20% integrated care + model (scenario 6), the integrated care model and the collaborative model are combined. Thus 20% of the midwifery practices integrate with hospitals and at the same time the formal collaboration between hospitals and the remaining independent midwifery practices is improved.

These two combined designs and the changes that are made in the SD model at t=10 are presented in Table 7-2. The results for each of the performance indicators are presented below. Note that in scenario 6 the sharp decrease at t=10 is caused by the introduction of the new system and the sudden move of pregnant women and staff at t=10 from midwifery practices to hospitals. After this sudden move, the dynamics of the system take over and a new equilibrium is found.

Performance Combined Inter-Organizational Designs

Medical performance is expressed as the percentage of high-risk pregnant women in the entire system (Figure 7-11). The models without collaboration, the improved hospital model (scenario 3) and the 20% integrated care model (scenario 4) performed better than the base case on this performance indicator. Even so, the improvement of formal collaboration in the improved hospital + model (scenario 5) and the 20% integrated care + model (scenario 6) results in a little better performance, since the quality of care that midwifery practices deliver is increased due to the increase in formal collaboration. This directly results in less low-risk pregnant women developing a high-risk pregnancy.

Effectiveness is expressed as the percentage of high-risk pregnant women in hospitals (Figure 7-12). Whether this percentage increases or decreases depends mostly on the perceived competition in the system. In the models without improved collaboration (the improved hospital model and the 20% integrated care model) the added midwives in the

Table 7-2 Overview of the combined inter-organizational designs and the changes in the model

Design/Scenario	Description of the scenario	Changes compared to base case (start at t=10)
5. Improved hospital + model	Advanced/clinical midwives are employed by the hospitals and formal collaboration between midwifery practices and hospitals is improved	1. Maximum quality of care in the hospitals will increase to 1*. 2. Start collaboration project***. See also Note 1 below.
6. 20% integrated care + model	A certain percentage of midwifery practices integrates with hospitals and the formal collaboration between the hospitals and the other midwifery practices is improved.	1. 20% of all pregnant women that are being cared for in midwifery practices will be transferred to the hospitals. 2. 20% of staff from midwifery practices will be transferred to the hospitals. 3. The maximum quality of care in the hospitals will increase to 1*. 4. Start collaboration project***. See also Note 1 below.
* When midwives are added to hospitals, the lack of *care* competences from the obstetricians will be compensated by the *care* competences from the added midwives. It is assumed that the new midwives and the obstetricians collaborate well and that they make sure that all pregnant women receive the right amount of *care* and *cure*.		
*** A collaboration project has the following characteristics: the project takes 52 weeks and the goal of the new level of formal collaboration is 0.8 (out of 1) (the current level is 0.4). The degree to which the collaboration is voluntarily is 0.8 (out of 1).		
Note 1. The percentage of low-risk pregnant women that is referred from the hospitals to the midwifery practices will not decrease to 0. In theory, the extra midwives in the hospitals are employed to improve the quality of care that the hospitals delivers to high-risk pregnant women, for as they need both *cure* from obstetricians and *care* from midwives. However, the objective of this scenario is to increase formal collaboration between midwifery practices and the hospitals and therefore it will be agreed upon that obstetricians will refer low-risk pregnant women to midwifery practices as the dynamics of the system dictate.		

hospitals will take care of the *care* needs of both low- and high-risk pregnant women, which makes the trust-loop (R1) turn into a vicious, rather than a virtuous cycle. However in the improved hospital + model (scenario 5) and the 20% integrated care + model (scenario 6) the improved collaboration results directly in more referrals between the organizations. In addition, compared to the models without collaboration, the improved collaboration results in higher quality of care in midwifery practices, which results in less low-risk pregnant women developing into a high-risk one. Even so, the improved collaboration results in more referrals between the organizations (even though trust does not increase necessarily), and as such in an increase of high-risk pregnant women being taken care of in the right organization.

The satisfaction of pregnant women is expressed by the delivered quality of care of hospitals (Figure 7-13), by the delivered quality of care of midwifery practices (Figure 7-14), and by the percentage of high-risk pregnant women in hospitals (Figure 7-12). In the models without improved collaboration (the improved hospital and the 20% integrated care model), the satisfaction of pregnant women decreases compared to the base case, as we have seen in Section 7.6.1. In the improved hospital + model (scenario 5) and the 20% integrated care + model (scenario 6), satisfaction is improved compared to the base case. The delivered quality of care in hospitals is increased due to adding midwives, the delivered quality of care in midwifery practices increases slightly due to the increase in collaboration, and the percentage high-risk pregnant women in hospitals increases. As such the combined models score better than their generic counterparts.

Satisfaction of professionals is expressed by the trust midwifery practices have in hospitals (Figure 7-15) and the trust hospitals have in midwifery practices (Figure 7-16). In the models without collaboration (the improved hospital model and the 20% integrated care model), trust that both type of organizations have in each other is damaged. Improving collaboration, as is the case in the improved hospital + model (scenario 5) and the 20% integrated care + model (scenario 6), is not sufficient to compensate for the perceived levels of competition by midwives.

Conclusion Combined Inter-Organizational Designs

The improved hospital model and the 20% integrated care model perform worse than the base casedue to the subtle vicious cycles of eroding trust and feelings of competition. Would these models work better if hospitals would try to overcome these feelings of competition, for example by intensifying the collaboration with the midwifery practices? The improved hospital + model and the 20% integrated care + model show that indeed performance increases; medical performance, effectiveness, client satisfaction and employee satisfaction increase compared to the improved hospital model, the 20% integrated care model, and even compared to the base case.

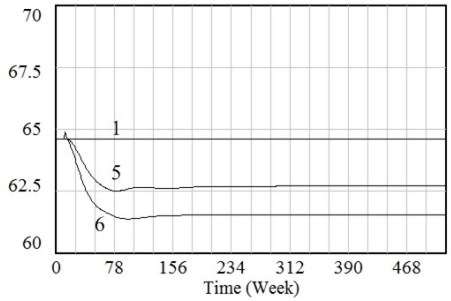

Figure 7-11 % High-risk women

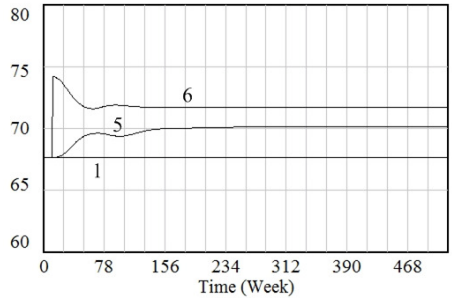

Figure 7-12 % High-risk women in hospitals

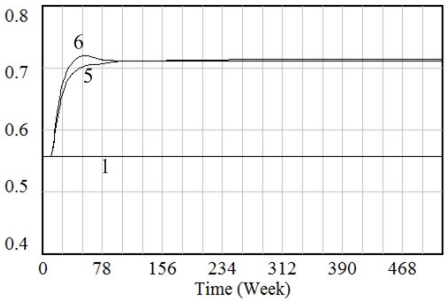

Figure 7-13 Delivered quality of care in hospitals

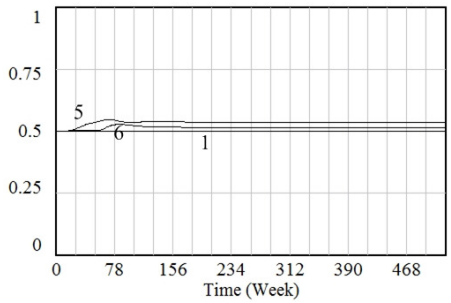

Figure 7-14 Delivered quality of care in midwifery practices

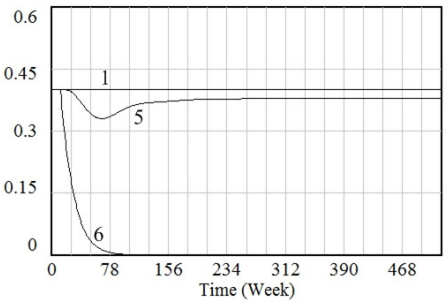

Figure 7-15 Trust midwifery practices have in hospitals

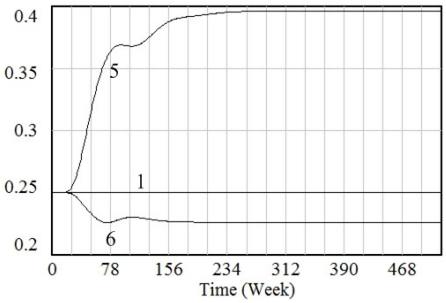

Figure 7-16 Trust hospitals have in midwifery practices

1. Base case
5. Improved hospital + model
6. 20% Integrated care + model

7.6.3 Sensitivity Analysis

Sensitivity analyses are conducted, regarding the assumptions made in the scenarios, the relations between the variables that have changed in a particular scenario and their first-order effects, and the comparative order of the scenarios. The sensitivity analyses reveal that our conclusions are robust to changes in the variables and relations. The sensitivity analyses are described in Appendix F.

Some findings from these analyses are the following. Firstly, when collaboration is made less voluntary, the performance of the scenarios where collaboration is improved all move very close to each other. Secondly, when the intended level of collaboration is set lower (0.6 instead of 0.8), only the collaborative model has an improved outcome in terms of percentage high-risk pregnant women taken care of by the wrong organization. All other scenarios perform worse than the base case regarding this outcome variable. Lastly, when the percentage of integration is set at 50%, the integrated care model and the integrated care + model have better performance than the other models. Thus, the higher the percentage of midwifery practices that integrates with hospitals, the better the outcomes.

7.7 Summary, Limitations, and Concluding Remarks

7.7.1 Summary

This chapter presents simulation research, in which the inter-organizational dynamics regarding collaboration and trust are combined with patient flows between midwifery practices and hospitals. Six inter-organizational designs in Dutch perinatal care are evaluated: (1) base case, (2) collaborative model, (3) improved hospital model, (4) 20% integrated care model (5) improved hospital + model, and (6) 20% integrated care + model. The different designs are judged based on their performance indicators (medical performance, effectiveness, satisfaction of pregnant women, and satisfaction of staff). When comparing the comparative order of the different designs, we have chosen to mainly focus on the effectiveness of the system, i.e. on the percentage of high-risk pregnant women that is being cared for in the right organization. We do not state that the other performance indicators are not important, but we do state that medical outcome is the main one.

Figure 7-16 shows the comparative order of the models, ranked from no integration to more integration. It shows that, even though all models are meant to improve performance, not all models result in having more pregnant women being taken care of in the right organization. The improved hospital model and the 20% integrated care model are aimed to improve the quality of care delivered within an organization. However, on a systems level, performance is decreased due to the subtle vicious cycles of eroding trust. As such, the desired order of

the six inter-organizational designs is (ranking best to worst): collaborative model, 20% integrated care + model, improved hospital + model, base case, 20% integrated care model, and the improved hospital model.

Sensitivity analyses (see Appendix F) show that the collaborative model has the best performance, that this performance is robust to changes in the scenarios' assumptions, and that, when focusing on the comparative order, this design is the most stable one. However, when the percentage of midwifery practices that integrates with hospitals increases, the integrated care + model performs is a very good alternative. Note that the model is intended to deal with the dynamics of inter-organizational collaboration and competition in a tiered system. As such the scenario of 100% integrated care is not modeled, for as then there is no inter-organizational setting any more.

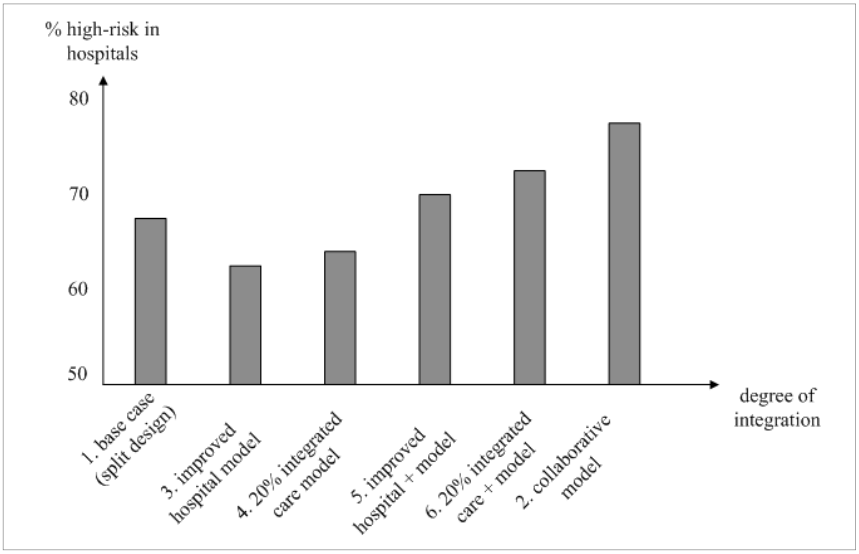

Figure 7-16 The inter-organizational designs compared

Note that, even though some reinforcing loops might be dominant, none of the scenarios keeps getting better or worse. This is due to boundary conditions set in the model. For example, soft variables such as formal collaboration, trust and quality of care are defined on a 0-1 scale. In addition, the existence of boundary conditions corresponds to reality. Due to the condition that pregnancy is, it will never occur that all pregnant women will develop a high-risk pregnancy, or that all pregnant women will have a low-risk pregnancy.

7.7.2 Limitations

First of all, in every model, the modeler has to decide what to put in the model and what not to put in the model. As such this model has some limitations. They are presented in

Appendix F, but some are provided below as an example. Firstly, it is assumed that pregnant women do not change their behavior to changes in quality of care; they will stay with their current care provider. One might expect that the quality of care will affect to which care provider pregnant women go to. However, the quality of care is hardly transparent, not on a national level (it is only since recently that the Netherlands is aware of its relatively bad performance) and certainly not on a provider level. Secondly, literature (Gittell and Weiss, 2004) and the interviews (Chapter 6) showed that interpersonal and group dynamics *within* an organization (between obstetricians and residents) might have an effect on the collaboration between organizations (midwifery practices and hospitals). However, the scope of the model is the inter-organizational level; we are interested in the dynamics *between* organizations and their effects on outcomes. Modeling the dynamics within an organization would be too detailed for our purpose. Thirdly, the model assumes that the national and financial structure in which the delivery of perinatal care is embedded does not change. However, it seems likely that changes in the financial system, for example introducing a bundled payment structure, will change the inter-organization collaboration within a care system (Tsiachristas et al., 2011).

Secondly, the quantified model includes several intangible factors. Healthcare is beset with problems of uncertainty, and therefore it might be overambitious to move beyond qualitative modeling into quantification (Coyle, 2000). A qualitative model was first developed based on conceptual group model building activities, and on the basis of this qualitative conceptual model, a quantified simulation model has been developed. Soft variables as quality of care, formal collaboration and trust are included in this model, since these soft factors are inherent to how this healthcare system works. A quantitative model has been developed since the care processes and behavior of the actors involved are so dynamically complicated and full of feedback loops that it is virtually impossible, based on a qualitative model alone, to determine under what conditions which scenario would be the most favorable. In addition, the variables and relations between them are not backed up with real numerical data, instead, they are based on interviews, group model building sessions, observation, and literature. Omitting structures or variables known to be important because numerical data are unavailable is actually less scientific and less accurate than using your best judgment to estimate their values (Sterman, 2002). To omit such variables and relations is equivalent to saying they have zero effect, which is probably the only value that is known to be wrong (Forrester, 1961). Even though all models are wrong, a quantitative model has its strengths, as long as one realizes that it will not present a definite answer to the research question: it allows one to play with assumptions and test different scenarios and it will present more insight into the problem in question than a pure qualitative model would do. Quantification helps to be very explicit and precise about what

assumptions have been made and about the robustness of the conclusions to changes in these assumptions (Sterman, 2000).

7.7.3 Concluding Remarks

The perspective taken in this research is that of improving Dutch perinatal care as a system, instead of improving performance of a single type of organization. As such, a clear finding from this research would be that for Dutch perinatal care the best thing to do is to implement the collaborative model, i.e. to improve collaboration between all independent midwifery practices and obstetric departments in hospitals.

A second finding would be that the improved hospital model performs the worst. As such, this research carries a warning for hospitals that choose, consciously or not, for an improved hospital model. If they do so, they might be able to deliver a higher quality of care and increase *their* performance, but the percentage of high-risk pregnant women that is being taken care of in the wrong organization (in the midwifery practices) will increase. As such, the performance of the *system* will decrease. The improved hospital model can increase performance of the system, but only when it is combined with increased collaboration with midwifery practices (scenario 5). Note that sensitivity analyses show that increasing collaboration only slightly worsens the performance compared to the current situation.

When only one or two midwifery practices decide to integrate with hospitals, whereas the bulk of the midwifery practices remain independent and outside of the collaboration, the performance in the system will get worse. Increasing the percentage of midwifery practices that integrates makes performance better, as well as improving collaboration between the integrated organization and the independent midwifery practices. Here also, sensitivity analyses show that improving collaboration just slightly still has a negative effect compared to the current situation.

These findings may come across as counter-intuitive to healthcare policy makers and perinatal care providers, especially in the current Dutch perinatal care setting. With regard to the first finding, the general tendency in Dutch perinatal care appears to be that a move towards integration is inevitable (e.g. Redactie Tijdschrift voor Verloskundigen, 2012). With regard to the second finding, for many Dutch perinatal care professionals the improved hospital model has been the default mode of increasing professionalism in perinatal care. In practice the subtle vicious cycles of eroding trust appears to be underestimated by many.

Chapter 8.

Discussion and Conclusion

8.1 Introduction

The healthcare sector is facing a multitude of problems: a steady rise in spending, an alarming rise of chronic conditions, and an aging population. One way of coping with this is to improve the *design* of the services provided. Two trends can be discerned. Firstly, traditionally healthcare services were designed from the perspective of the organization and the professional. Healthcare organizations were organized functionally, per discipline and geographically, with each specialism having its own department or organization. Apparently, this is not working well: it resulted in fragmented, poorly coordinated care and low service quality. Instead, healthcare services are more and more designed from the perspective of the patient. Secondly, traditionally, care is delivered according to the "acute care" model. It is specialist care, focused on medical intervention, delivered in hospitals. Nowadays, it is more and more recognized that healthcare can be improved by refocus toward proactive maintenance. Care must reach beyond the traditional healthcare organizations into patients' lives in the community, and patients should be given increased responsibility for the day-to-day management of their disease

This research focuses on *care-cure* conditions. These conditions have in common that patients have needs at three levels. Most of the time, the needs of patients can be met by self-management, by monitoring their condition themselves. Secondly, patients have needs regarding general, preventive monitoring, education, psycho-sociological support, basic medical support, etcetera (need for *care*). Thirdly, in case of an episode, patients need specialized, medical intervention (need for *cure*). Thus, patients need a combination of *care* activities and *cure* activities. Not only do most chronic conditions fit this category, also some mental health disorders (such as depression) and pregnancy do.

Care and *cure* can be delivered by the same professional, although, in the highly specialized practice of healthcare, they are mostly delivered by different professionals. For diabetes, a specialized diabetes nurse is an example of a *care* professional, whereas the vascular surgeon is an example of a *cure* professional. In what kind of organizations these professionals work varies across sites. Literature shows that there are different inter-organizational designs in place, varying from organizations being able to meet both the *care* and the *cure* needs, such as specialty hospitals, to organizations that are specialized in meeting only a specific need, such as community specialized nurses, and from organizations that focus on patients with one particular condition, such as specialty hospitals to organizations that focus on various conditions, such as primary care centers. One of the main problems with the current designs are problems of fragmentation and coordination, and it is not known yet what design would work best. This brings us to the research objective: *What inter-organizational design would work best for care-cure*

conditions, so that patient's needs are met, and that problems due to fragmentation are overcome?

This research applies a mixed method approach and aims to contribute to theory development regarding inter-organizational designs in the healthcare sector through case study research and through simulation. The case setting is Dutch perinatal care and the simulation method used is system dynamics modeling (see Chapter 3).The case study consists of three phases, each with their own methods. Limitations to these methods used are discussed in the associated chapters (Section 4.7, Section 5.5, Section 6.6, and Section 7.7). Construct validity, internal validity, external validity, and reliability are discussed in Section 3.8.

This chapter presents contributions at three different levels: for Dutch perinatal care (Section 8.2), for other perinatal care systems (Section 8.3), and for *care-cure* conditions (Section 8.4). In each of the sections, the results and limitations are discussed, and recommendations for further research are made.

8.2 Dutch Perinatal Care

Dutch perinatal care has problems regarding perinatal and maternal morbidity and mortality rates, and the satisfaction of pregnant women is not as high as one would strive for (see Chapter 4). A review of the literature shows that reasons for this malfunctioning can be found in the characteristics of the pregnant women, in the efficiency of the current system, but also in the structure, the design, of the current system. This study shows (Chapter 4) that the current design of Dutch perinatal care is organized in line with principles of the focused factory concept, – even while the system has never been explicitly set up as such. The population of pregnant women is split in low-risk and high-risk pregnant women, with low-risk pregnant women being cared for by midwifery practices, where midwives specialize in meeting *care* needs, and with high-risk pregnant women being cared for by obstetric departments in hospitals, where obstetricians specialize in meeting *cure* needs.

From an operations management perspective, one would expect a system to operate according to its design (Section 3.4). For Dutch perinatal care, this implies that one would expect low-risk pregnant women to mainly be taken care of in midwifery practices, and high-risk pregnant women to be taken care of in hospitals, since that is the official design. However, our archival data analysis regarding the care process from one hospital and one midwifery practice in the city of Tilburg (see Chapter 5) shows that the perinatal care system does not achieve a good fit between how it is designed and how it operates in practice. Apparently low-risk pregnant women are being taken care of in hospitals and the

majority of pregnant women that is being taken care of in midwifery practices has to consult the hospital. We found several reasons for this misalignment. There are certain characteristics of a pregnancy that make a design based on low-risk and *care* on the one hand and high-risk and *cure* on the other hand, a tricky one: one cannot determine in advance if a pregnancy will turn out to be a low-risk or a high-risk pregnancy and pregnant women, regardless of their risk level, have both *care* and *cure* needs. In addition, organizational inertia and stickiness prevent pregnant women to be referred between organizations in time; both hospitals and midwifery practice are reluctant in referring "their" clients to the other organization. Also, preferences and behavior of pregnant women are aligned towards high-level care (*cure*).

An in-depth case study in Tilburg and its surrounding villages (see Chapter 6) shows that a lack of trust, feelings of competition, a sub-optimal exchange of information and sub-optimal communication between midwifery practices and hospitals stand in the way of successful collaboration. And this collaboration is important since pregnant women, due to the nature of pregnancy, flow or should flow from midwifery practices to hospitals and vice versa, based on changes in their risk levels and based on their needs for *care* and *cure* over time.

The archival data analysis and the in-depth case study are conducted in Tilburg. Are these results generalizable to perinatal care in the Netherlands? Or are these results specific to the "Tilburg situation"? Regarding the characteristics of a pregnancy (ex-ante predictability and the need for both *care* and *cure*), they apply to pregnancies in general and they are not region specific. Regarding the inter-organizational dynamics (collaboration, trust, competition), we believe it does apply to other regions in the Netherlands as well. Other research also acknowledges such problems between midwifery practices and obstetric departments in Dutch perinatal care (De Leede et al., 2012; Veer and Meijer, 1996). In addition, there are very few regional differences between the regional perinatal care systems in the Netherlands. The Dutch perinatal care system has been organized more or less the same throughout the Netherlands. The structure, the financial system, and the decision criteria to decide which category a pregnant woman belongs to, all these are determined at a national level (see Chapter 4). Last but not least, it is not only Tilburg that faces low scores on perinatal and maternal morbidity and mortality; all regions in the Netherlands are coping with this problem, and Tilburg has even one of the lowest rates (De Graaf et al., 2012).

In the in-depth case study, improvements are defined and being implemented. The improvements focus on specific areas: improving the exchange of information, streamlining care processes that extend organizational boundaries, and getting to know each other better. These improvements all focus on intensifying collaboration between midwifery practices

and hospitals, while maintaining the current organizational boundaries. One could state that the Tilburg region is moving towards a collaborative model of delivering perinatal care.

In the last years, in addition to the collaborative model, two more models of improvements can be found. Firstly, more and more hospitals employ specialized midwives, in order to be able to meet the *care* needs of pregnant women more (improved hospital model). Secondly, some hospitals have integrated with one or more midwifery practices (20% integrated care model), while the other midwifery practices in a region would remain independent. However, what model or design would work best?

With the insights from the case study and the literature review, a system dynamics simulation model is designed with which different inter-organizational designs are evaluated (see Chapter 7). Four basic models are evaluated: the current situation (base case), the collaborative model, the improved hospital model, and the 20% integrated care model. In addition, two combined models are evaluated: the improved hospital + model, which combines the improved hospital model with the collaborative model, and the 20% integrated care + model, which combines the 20% integrated care model with the collaborative model. All the models are evaluated on four performance indicators: medical performance, effectiveness of the system, client satisfaction and employee satisfaction.

For Dutch perinatal care, the model shows that the best thing to do is to implement the collaborative model, i.e. to improve collaboration between all independent midwifery practices and obstetric departments in hospitals. Collaboration in this research is marked by knowledge contribution, equal distribution of power, and a focus on achieving best outcomes without regard to discipline, hierarchy, or even organizational boundaries (Kinnaman and Bleich, 2004). In Dutch perinatal care, most of this collaboration is voluntarily; there are no checks on whether or not organizations comply with the agreements made, and there are hardly any sanctions when organizations do not comply. The collaborative model, where collaboration between *care* and *cure* organizations is improved, is optimal, because of the virtuous cycles of trust and transparency that are nurtured in this setting. The improved hospital model where hospitals improve their quality of care by adding professionals with *care* competencies to their *cure*-competencies-driven organization, results in sub-optimization. Although the performance of the hospitals increases, the percentage of high-risk pregnant women in midwifery practices will increase too; since hospitals refer less low-risk pregnant women to midwifery practices, trust midwifery practices have in hospitals decreases and thus increases the number of high-risk pregnant women in midwifery practices. As such, performance on a systems level decreases. This model might only work if at the same time the collaboration with the midwifery practices is increased (improved hospital + model) so trust is fostered. In addition, the competition-driven model, where some (20%) of the *care* providers

(midwifery practices) are closely integrated with *cure* providers (hospitals) is found to lead to inferior results as well (integrated care model), due to the same reason as mentioned above with the improved hospital model. Here too, its performance can be increased when at the same time the collaboration between the hospital and the remaining independent midwifery practices is improved (integrated care + model) or when the percentage of midwifery practices that integrates with the hospital is increased.

The findings may come across as counter-intuitive to healthcare policy makers and perinatal care providers, especially in the current Dutch perinatal care setting. With regard to the first finding, that the collaborative model would work best, the general tendency in Dutch perinatal care appears indeed to be that a move towards integration is inevitable (Amelink-Verburg et al., 2012; De Leede et al., 2012; Huijbrechts, 2012; Redactie Tijdschrift voor Verloskundigen, 2012; Zum Vorde sive Vording and Meiboom, 2012). With regard to the second finding, for many Dutch perinatal care professionals the improved hospital model has been the default mode of increasing professionalism in perinatal care. In practice the subtle vicious cycles of eroding trust appear to be underestimated by many.

There might be some limitations to these conclusions. The model does not present Dutch perinatal care in all its details, especially not regarding the micro and the macro level (see also Section 7.7.2 and Appendix F). On the micro level, clinical details, such as interventions, are not modeled. Even so, collaboration within an organization, such as the hospital, is not modeled explicitly and other professionals than midwives and obstetricians, such as residents and nurses, are not incorporated in the model. On the macro level, policy and the financial structure of the Dutch healthcare system are not taken into account explicitly as well. One has to keep in mind that the model is a representation of reality. Every model has a certain aim, and the aim of this model is to study the interaction between the inter-organizational designs, inter-organizational dynamics, such as collaboration and trust, and performance of the system (flow of pregnant women through the system).

In addition, the model includes several intangible factors such as collaboration, trust, quality of care, and therefore it might be overambitious to move beyond qualitative modeling into quantification (see Section 7.7.2). However, omitting structures or variables known to be important because numerical data are unavailable is actually less scientific and less accurate than using your best judgment to estimate their values (Sterman, 2002).

Even though all models are wrong, a quantitative model has its strengths, as long as one realizes that it will not present a definite answer to the research question: it allows one to play with assumptions and test different scenarios and it will present more insight into the problem in question than a pure qualitative model would do. Quantification helps to be very

explicit and precise about what assumptions have been made and about the robustness of the conclusions to changes in these assumptions (Sterman, 2000).

One of the suggestions for further research would be to include other professionals that are part of the care process. This research focuses on the main professionals: midwives and obstetricians. However, the interviews (see Chapter 6) showed that midwives are dissatisfied with the professional relationship with residents and that, according to midwives, obstetricians are partly to blame for this. Therefore, one might want to gain more insight into the triangular relation between residents, obstetricians, and midwives. In addition, other professionals then residents might need to be involved in the care process, such as general nurses, physiotherapists, pediatricians, general practitioners and maternity care nurses. What is the effect of the collaboration of midwives and obstetricians with those other professionals on the actual delivery of care? Will they have an effect on what inter-organizational design would work best in Dutch perinatal care?

Finally, knowing what inter-organizational design would work best is one thing; actually changing the system is something else. This is not within the scope of this research, but certainly not of less importance.

8.3 Other Perinatal Care Systems

This research reports on a case study conducted in Dutch perinatal care, but it has implications for perinatal care systems in other countries as well. What these implications are depends on the system that is in place. Different systems are based on different ideologies. The two most extremes are the medical model (or illness-model) and the midwifery model (or wellness-model). In the medical model, pregnant women are primarily being cared for by obstetricians within a medical, hospitalized setting. Almost on the other side of the spectrum we find the midwifery model, stating that being pregnant and giving birth are healthy and natural events, physiological processes, involving no illness or disease. This model has a larger midwifery population and/or more primary care facilities that take care of low-risk pregnancies, as is for example the case in the Netherlands. As a result of these different ideologies, different inter-organizational designs exist: in some care is only delivered in a hospital setting by obstetricians, and in others care is delivered in a combination of obstetricians in hospitals and midwives, either working independently or in hospitals.

For perinatal care systems which are built on the medical model, the Dutch perinatal care system is often set as an example to learn from. The Dutch system performs well with regard to the number of obstetric interventions and the number of home births, which is

attributed to the midwifery model that the Dutch system is based on (see Chapter 4). For the United States, whose perinatal care system very strongly adheres to the medical model, it is recommended to de-medicalize childbirth and to train far more midwives, who up to now mostly play a marginal role in the healthcare system, due amongst others to a combination of state intervention and market forces (Goodman, 2007; Gabay and Wolfe, 1995). However, since the Dutch perinatal care system is based on the midwifery model for decades, it is also a good system to learn from with regards to the aspects that do not work well. This research carries the advice to be careful with introducing independent midwifery practices. Choosing an inter-organizational design in which there is a clear split between midwifery practices that focus on low-risk pregnant women and obstetric departments in hospitals that focus on high-risk pregnant women will not work, since it is not known in advance whether a pregnancy will turn out to be a low- or a high-risk one, and since pregnant women need both *care* and *cure* (see Chapter 5). Having independent midwifery practices only works well when there are high levels of collaboration and trust with the *cure* providers, i.e. obstetric departments in hospitals. Otherwise, feelings of competition will dominate and pregnant women will receive less optimal care (see Chapter 6 and 7). Instead of introducing independent midwifery practices that focus on low-risk pregnant women, it might be better to have midwives working side by side with obstetricians in the same organization, in one team. Working side by side in one team requires that there is an equal relation between midwives and obstetricians, that they both value and respect each others' perspective and that they both acknowledge that pregnant women do need both *care* and *cure*. Problems regarding differences in background, power, etcetera, need to be overcome (see also the literature review on collaboration in Chapter 2). Working side by side does not necessarily imply working in one geographical location; midwives can, for example, also conduct consultations in community centers so that access to their services is improved. In addition, policy and financial structures need to be designed in such a way that they support good behavior, i.e. genuinely working side by side and respecting each other, and that they do not support competitive behavior where professionals do not want to refer pregnant women to other professionals since that would imply a loss in income. A fee for service structure, what the United States is familiar with, might therefore not be the best solution, and a bundled payment system might work better.

For perinatal care systems that are based on the midwifery model and that consist both of obstetric departments in hospitals and of midwifery practices, this research carries the following advice. When improving perinatal care, one has to be careful with improving the care process in one organization only, since this might result in sub-optimization, especially when the system expects pregnant women to be referred between organizations when their risk level changes. Improving the care process in the hospitals might result in better performance *in* the hospitals, but because of vicious cycles of eroding trust between

hospitals and midwifery practices, performance of the system *as a whole* might decrease (see Chapter 7).

8.4 *Care-Cure* Conditions

This research aims to contribute to theory development regarding inter-organizational designs in healthcare, in particular for *care-cure* conditions. The literature (see Chapter 2) showed that currently different inter-organizational designs are in place for *care-cure* conditions, each with its flaws. The research question therefore is: What inter-organizational design would work best for *care-cure* conditions, so that patients' needs are met, and that problems due to fragmentation are overcome? This study focuses on one particular *care-cure* condition, pregnancy, in one particular country, the Netherlands.

Although pregnancy is a *care-cure* condition, it also is a special *care-cure* condition. It differs from other *care-cure* conditions as cardiovascular risk, diabetes mellitus, chronic obstructive pulmonary disease, and congestive heart failure. Firstly, one is pregnant for a certain time (i.e. nine months), whereas other *care-cure* conditions are more life-long conditions. Secondly, most pregnant women do not have co-morbidities, whereas other *care-cure* conditions, which are often developed later in life, are known for their co-morbidities. This co-morbidity is likely to result in a more complex overall care process, with more professionals and more organizations involved, since healthcare is a very specialized and fragmented sector. However, Dutch perinatal care is still a good system to study inter-organizational design for *care-cure* conditions with. Firstly, whereas with many *care-cure* conditions only recently awareness is raised for the psychosocial aspects, the Dutch perinatal care system is known for its focus on *care*, since it has been operating according to the midwifery model for decades. Secondly, Dutch perinatal care is a clear system: only two types of organizations are involved, and it is set up the same throughout the whole country. Dutch perinatal care is organized as a tiered system: midwifery practices take care of low-risk pregnant women and obstetric departments in hospitals take care of high-risk pregnant women. It seems to make sense to first understand the dynamics in a "simple" healthcare network (two types of providers) with a condition that does not know too many co-morbidities (pregnancy).

So what does this case study teaches us? This research consists of three phases, with each phase focusing on a different aspect of the inter-organizational design of Dutch perinatal care. Firstly, insight had to be gained into the performance of the current system. Secondly, it had to be understood what the reasons are why the current system does not work well. And thirdly, recommendations on how to improve the system needed to be defined. As such, this research has a variety of implications for *care-cure* conditions.

Overall this research teaches us that the inter-organizational design (a tiered system) has an effect on inter-organizational dynamics such as collaboration and trust, on the operations such as patient flows through the system, on patient's health and wellbeing, and on the interaction between those three. Thus a structural solution (having independent *care* and *cure* organizations, which take care of respectively low-risk and high-risk patients) can result in unintended dynamics in the system: that of organizations not trusting each other, having patients being cared for in the wrong organization with the associated consequences. Having low-risk patients in *cure* organizations might result in higher costs; having high-risk patients in *care* organizations might be dangerous from a health perspective. Due to vicious cycles of eroding trust, solutions have to be sought in improving the system by increasing levels of collaboration or by fully integrating. Improving care in only a part of the system (i.e. in certain organizations, such as in hospitals) will likely result in sub-optimal care in the system.

More specifically, the following four implications can be made. Firstly, this research recommends that when evaluating the performance of a healthcare system, one should not only look into costs and medical performance, but also into the degree of fit between the organizational *design* and the actual *practice*. Most studies regarding the performance of organizational designs in healthcare focus on comparing costs and medical performance. For example, when comparing the designs for COPD patients in the Netherlands with those in the United Kingdom, focus was on aspects such as COPD prevalence, average length of stay in hospital, percentage of COPD patients with medical subscription and costs (Utens et al., 2011). These studies focus on the outcomes that are the result of a certain design, they do not focus on the applicability of the designs itself in terms of internal and external fit. As we have seen in Dutch perinatal care, financial performance was fairly good compared to other countries, and so was medical performance in several respects, albeit that there were increasing doubts. It was only through the in-depth inspection of the performance of two particular organizations and their operations that we could reveal *underlying organizational design flaws*, in terms of lack of fit (see Chapter 5).

Secondly, this research shows that a design based on the focused factory concept, with separate organizations for different risk levels (low-risk versus high-risk) or for different needs (*care* needs versus *cure* needs) might not work for *care-cure* conditions. A main characteristic of *care-cure* conditions is that the risk level of patients can change over time and that as such patients have different needs. In addition, for most *care-cure* conditions, it is hard to determine in advance if patients, over the course of their treatment, end up in one level of the disease or in the other (low-risk versus high-risk). Lastly, having a system in line with the principles of the focused factory concept might create organizational inertia and stickiness. This prevents patients to be referred between organizations in time when it is needed.

Thirdly, one of the reasons why the Dutch perinatal care system did not work well is due to inter-organizational dynamics: a lack of inter-organizational collaboration and trust stands in the way of referring pregnant women between organizations. The literature on collaboration shows that there are several drivers and barriers to collaboration. However, in order to know which are the most important ones in a particular situation, one has to study the case setting in detail. As such, this research (see Chapter 6 and 7) recommends studying the dynamics of the collaboration between professionals/organization in relation to the condition specific characteristics in detail *before* deciding what inter-organizational design might work best. For example, in Dutch perinatal care, obstetric departments are able to take care of low-risk pregnant women, which results in competition between *care* and *cure* providers (respectively midwifery practices and obstetric departments). For other conditions, it might not be possible for the *cure* providers to also take care of the patients who only need *care*. As a result, the *care* organization might not have to fear the *cure* organization of "stealing patients". In addition, the care process for pregnant women encompasses about eight months. This affects professional behavior; when high-risk pregnant women develop a low-risk pregnancy later in the pregnancy, obstetricians are often reluctant to refer them to midwifery practices for as they have been taking care for those women for already six months or so. Why change the continuity of caregiver for the last two months? This referring behavior might be different for chronic diseases. For example, a study regarding referral behavior of diabetics in the United Kingdom showed that the following had an effect on referral behavior: geographical accessibility, availability of specialists in a community setting, waiting times for first appointments, communication, quality of care, and continuity of staff (Nocon et al., 2003).

Fourthly, the simulation model recommends implementing a collaborative model and it shows that improving care in only a part of the system (i.e. in certain organizations) will likely result in sub-optimal care in the system. However, the model is based on pregnancy in the Netherlands, and as such there are some differences with *care-cure* conditions and with the structure of healthcare systems in other countries. These difference might have an effect on the structure of the model and thus on the outcomes. Firstly, pregnancy differs from *care-cure* conditions. The latter are often characterized by the existence of co-morbidities and by being a chronic condition. As such, the care process might be more complex and require more professionals and more organizations. For example, someone with both COPD and diabetes might visit the following *cure* professionals: pulmonologists, transplant surgeons, cardiologists, endocrinologist, vascular surgeons, podiatrists, gastroenterologists and ophthalmologists. In addition, many different *care* professionals can be involved: nursing professionals, nutritionists, exercise physiologists, diabetic educators, physiotherapists, pharmacists, social workers and more. Secondly, there are differences between the Dutch healthcare system and healthcare systems in other countries. The Dutch

healthcare system is characterized by a clear structure in which there is not a lot of variation in the type of organizations and the type of professionals that delivers care. In addition, the Dutch system hardly knows any competition in terms of quality or effectiveness, and insurance companies refund all care providers. After decades of central price and capacity control by government, the Dutch healthcare system is now in transition from supply-side regulation toward managed competition (Westert, Burgers and Verkleij, 2009; Van de Ven and Schut, 2008). Insurance companies gain more and more insight in outcomes and quality of services that healthcare organizations deliver, and as such they negotiate contracts based upon that information. The next step is to have an adequate system of consumer information on price and quality of insurers and healthcare providers to enable effective consumer choice (Van de Ven and Schut, 2008). These two differences – type of condition and type of healthcare system – have an effect on the system dynamics model. For example, the model assumes that behavior of pregnant women (to which organization they present themselves) does not change as a response to changes in the quality of care that the organizations deliver. In the case of Dutch perinatal care this is justified. In the Dutch system, quality of care is hardly visible to patients. And even if it were visible, due to the two-tiered structure, it is more or less prescribed that pregnant women presents themselves to the lowest type of care possible, i.e. independent midwifery practices. For other countries, the behavior of pregnant women might change due to quality of care that is delivered. For example, in the United States health insurers have more influence in where pregnant women are being taken care of, since they negotiate with healthcare providers on quality and costs, and as a result close contracts with certain healthcare providers and not with others.

A suggestion for further research would be to conduct a similar study for a *care-cure* condition that involves chronic patients with a high-risk of co-morbidities. *Care-cure* conditions such as diabetes, COPD, and heart failure are known for their co-morbidities which results in a larger number of main different professionals that are involved, over a larger time period. How do these two variables – time and number of main professionals involved – affect the inter-organizational design that would work best? What are the dynamics of inter-professional collaboration and how do they affect the actual delivery of care? And would these be different in healthcare systems other than the one in the Netherlands?

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Appendix A

Questionnaire

Appendix A. Questionnaire

Answers on a 1-5 Likert Scale.

Transparency

1. We provide the other with any information that might help them to plan for our needs.
2. We provide the other with feedback about how they are performing periodically.
3. We communicate the specifications and quality requirements clearly and accurately to the other.
4. Exchange information between the others and us takes place timely and frequently.
5. It is expected that we keep each other informed about events or changes that may affect the other.

Trust

6. We have strong personal confidence in one another.
7. We have strong business confidence in one another.
8. The other keeps promises it makes to us.
9. We believe the information that the other provides us.
10. The other is genuinely concerned that our business succeeds.

Performance

11. In general, how satisfied have you been with the overall performance your relationship with the other.
12. I expect this relationship to help us functioning better.
13. A characteristic of this relationship is flexibility in response to requests for changes.
14. Our relationship has positively attributed to the following performance objectives:
    a. efficiency
    b. innovation of products/services
    c. lower costs
    d. increased quality of our work
    e. increased service to our patients

Power

15. Problems that arise in the course of this relationship are treated as joint rather than individual responsibilities.
16. The responsibility for making sure that the relationship works for both the other party and us is shared jointly.
17. We expect this relationship to last a long time.
18. The relationship we have with this supplier resembles a stronger marriage.

19. We depend more on the other, than the vice versa.

Effort

20. In this relation, we lose a lot of time to unproductive conversation about, for example, who responsible is for problems.
21. When some unexpected situation arises, the parties would rather work out a new deal than to hold each other to the original terms / It is expected that the parties will be open to modifying their agreements of unexpected events occur.
22. Sharing each other's working methods helps understanding each other better.
23. The development of mutual performance indicators may be an instrument for further process improvements.
24. Common consultations about the introduction of new working methods enhances the quality of our product and the services to our clients.

Appendix B

Results Questionnaire

Appendix B. Results Questionnaire

		South region	South region	North region	North region	Tilburg	Tilburg
		M	O	M	O	M	O
		n=9 (12)	n=7 (8)	n=12 (12)	n=7 (7)	n=21 (24)	n=14 (15)
Transparency							
	1	5.5	5.2	5.6	5.0	5.5	5.1
	2	5.7	4.3	4.5	4.0	5.0	4.2
	3	5.2	5.2	4.3	4.6	4.7	4.9
	4	5.1	5.5	5.4	4.1	5.3	4.8
	5	6.0	5.8	5.8	5.7	5.9	5.8
Trust							
	6	5.3	4.8	5.4	5.1	5.4	5.0
	7	6.0	4.5	5.9	5.6	6.0	5.0
	8	4.2	5.0	5.7	5.4	5.0	5.2
	9	5.3	5.8	6.0	6.0	5.7	5.9
	10	5.0	4.3	5.7	5.4	5.4	4.9
Performance							
	11	5.5	4.8	6.0	5.3	5.8	5.1
	12	6.1	5.3	6.2	6.0	6.1	5.7
	13	5.6	5.3	5.9	6.1	5.8	5.7
	14.a	4.9	4.2	4.7	4.6	4.8	4.4
	14.b	4.4	3.8	4.0	4.4	4.2	4.1
	14.c	2.7	2.3	3.3	3.9	3.0	3.1
	14.d	5.5	3.7	5.1	4.7	5.3	4.2
	14.e	5.7	3.7	5.1	5.0	5.3	4.3
Power							
	15	5.4	4.2	5.2	4.1	5.3	4.2
	16	5.1	3.7	5.3	4.3	5.2	4.0
	17	6.2	6.0	6.2	6.1	6.2	6.1
	18	5.6	5.3	5.2	5.7	5.4	5.5
	19	4.6	1.5	3.8	4.3	4.1	2.9
Effort							
	20	3.7	4.7	2.5	3.6	3.0	4.1
	21	6.0	5.7	5.4	5.4	5.7	5.5
	22	6.2	5.7	6.0	6.0	6.1	5.8
	23	6.4	6.0	5.7	6.6	6.0	6.3
	24	6.5	5.7	6.2	6.6	6.3	6.1

M = midwives, O = obstetricians

Transparency

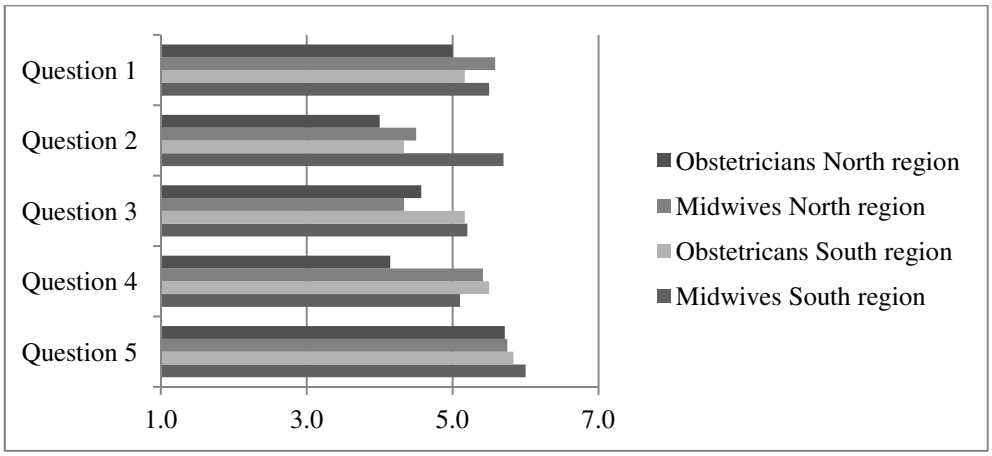


Figure B-1 Transparency per profession per region

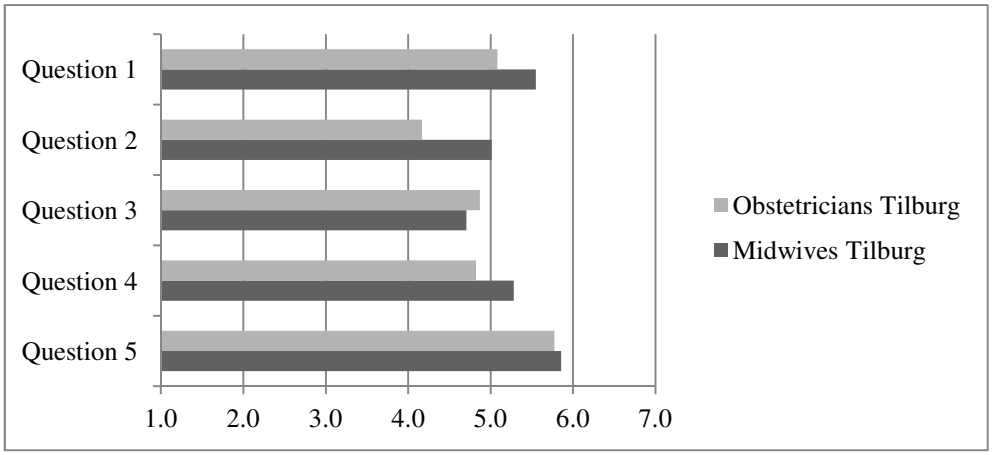


Figure B-2 Transparency per profession

Trust

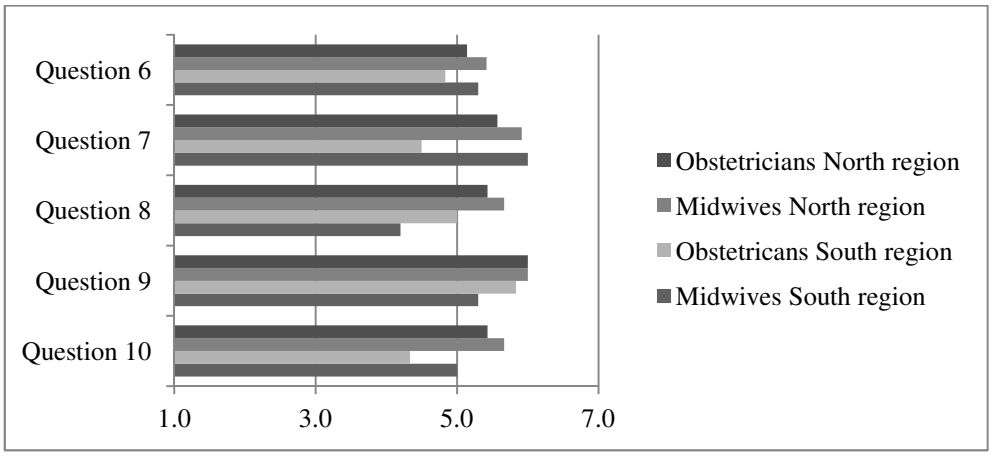


Figure B-3 Trust per profession per region

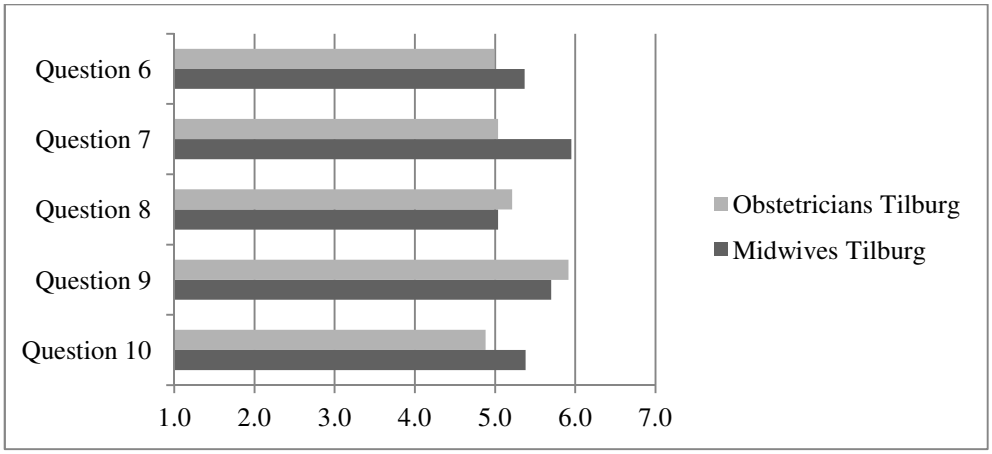


Figure B-4 Trust per profession

Performance

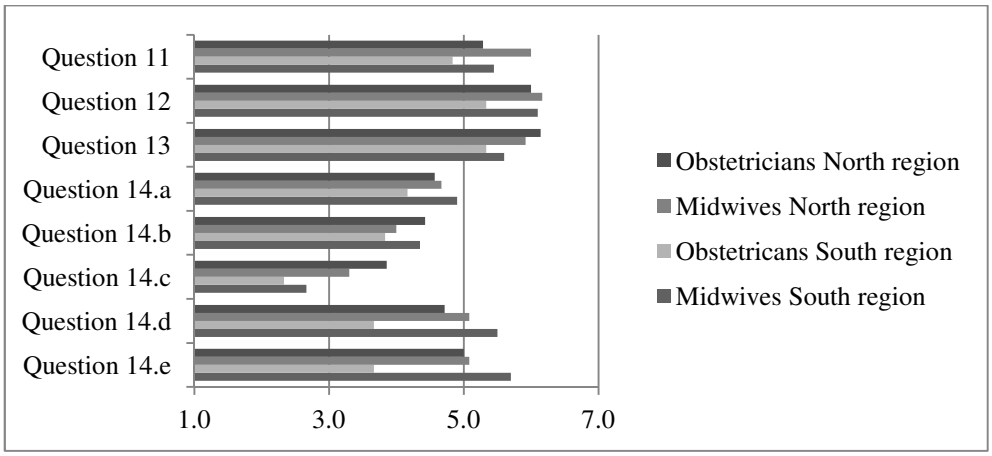


Figure B-5 Performance per profession per region

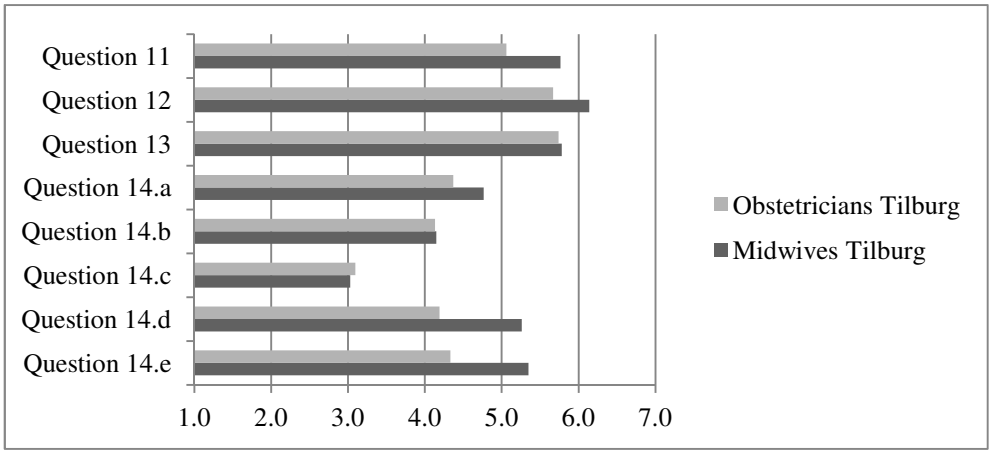


Figure B-6 Performance per profession

Power

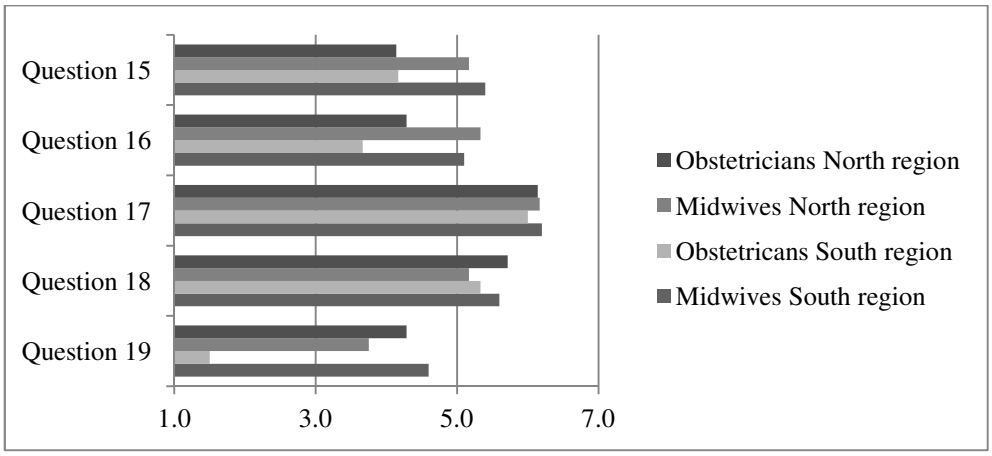


Figure B-7 Power per profession per region

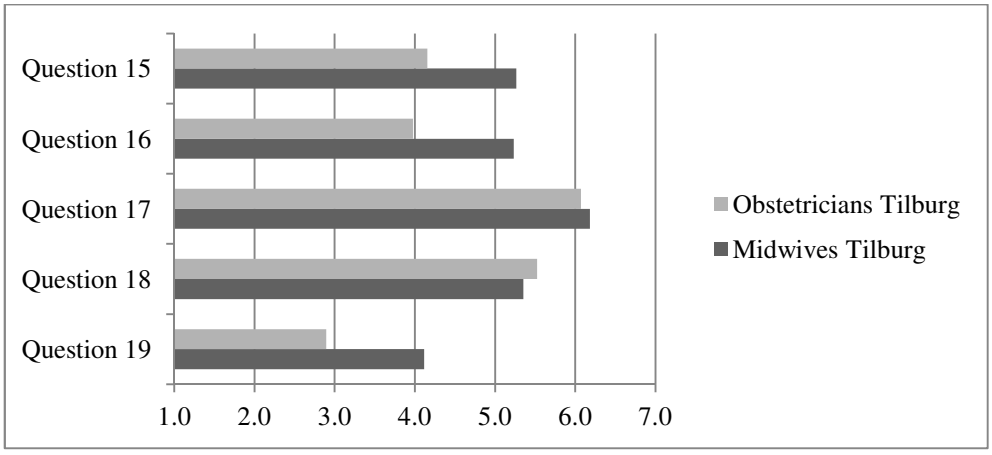


Figure B-8 Power per profession

Effort

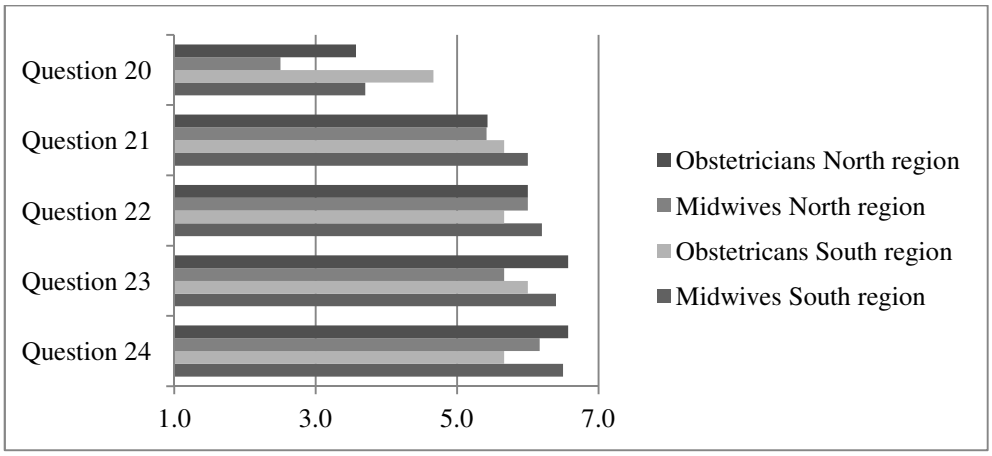


Figure B-9 Effort per profession per region

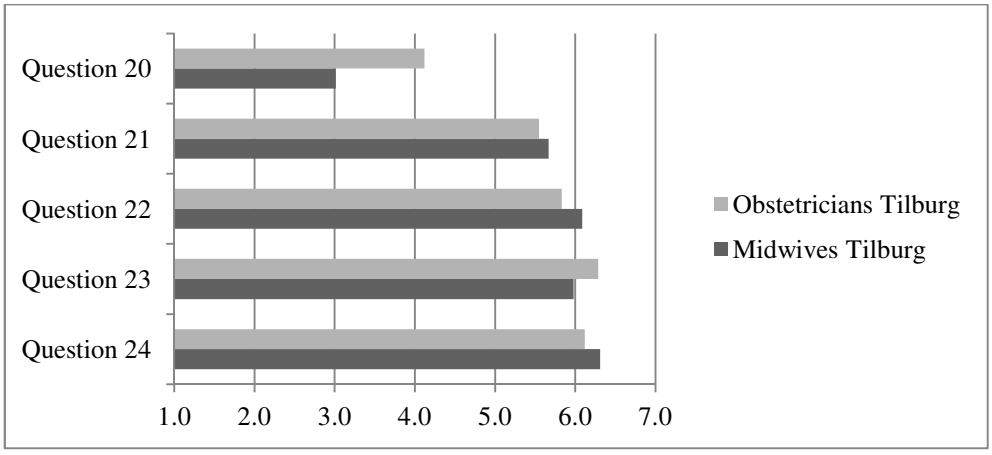


Figure B-10 Effort per profession

Appendix C

Causal Loop Diagrams

Appendix C. Causal Loop Diagrams

This appendix presents the causal loop diagrams that were drawn in the group model building sessions with the midwives and the obstetricians (see Chapter 6). The following diagrams are presented:

- Figure C-1 How to achieve high quality of care (with a focus on communication and trust) (by midwifery practice)
- Figure C-2 Competition and collaboration between midwifery practices (by midwifery practice)
- Figure C-3 Consequences of using protocols (by midwifery practice)
- Figure C-4 Having a shared vision: Preventive Support of Labour (PSoL) (by midwifery practice)
- Figure C-5 Performance of De Kring (by midwifery practice)
- Figure C-6 Collaboration and competition between midwifery practices (by midwifery practice)
- Figure C-7 Consequences of having one hospital that works according Preventive Support of Labor (PSoL) (by midwifery practice)
- Figure C-9 Time for pregnant women (by obstetricians)
- Figure C-10 Relationship between midwives and obstetricians (by obstetricians)

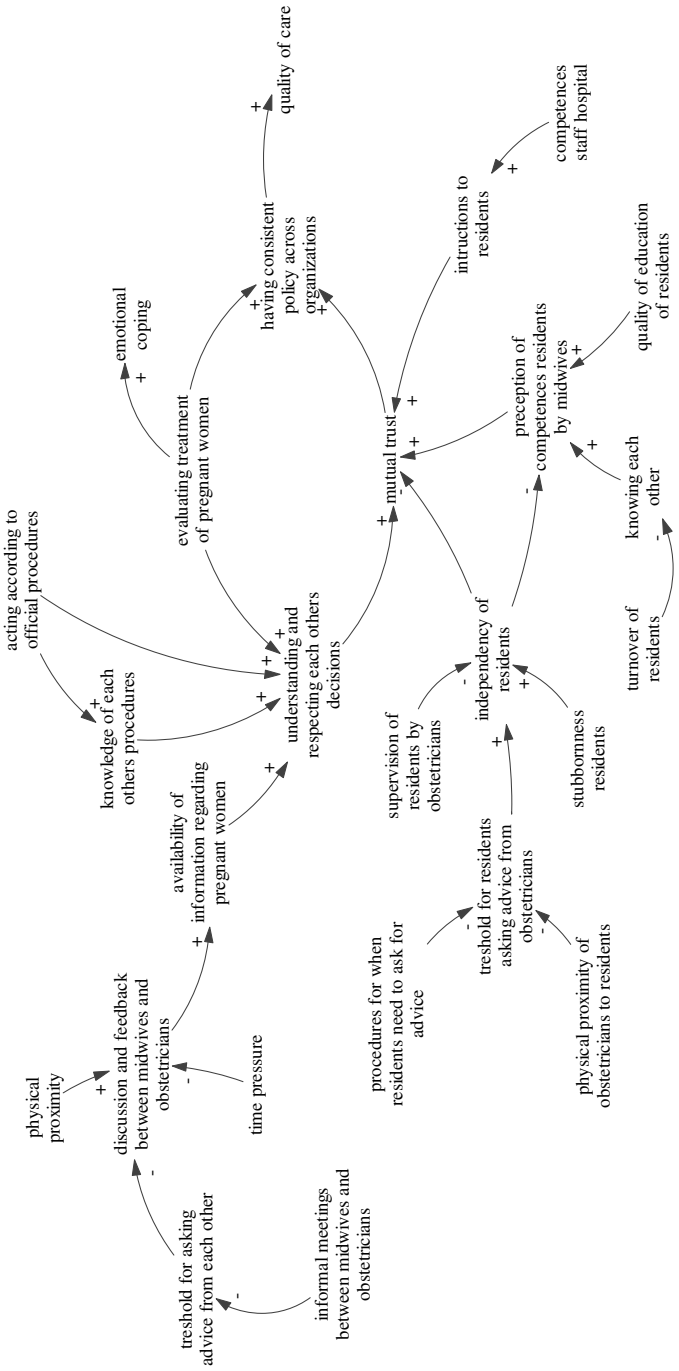


Figure C-1 How to achieve high quality of care (with a focus on communication and trust) (by midwifery practice)

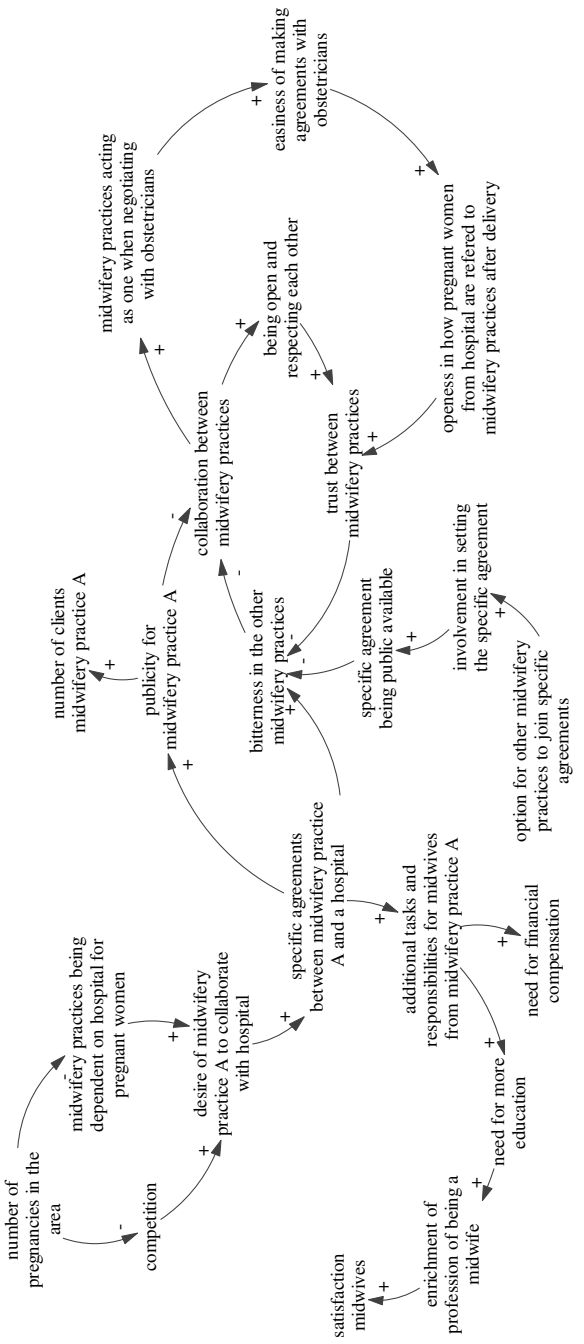


Figure C-2 Competition and collaboration between midwifery practices (by midwifery practice)

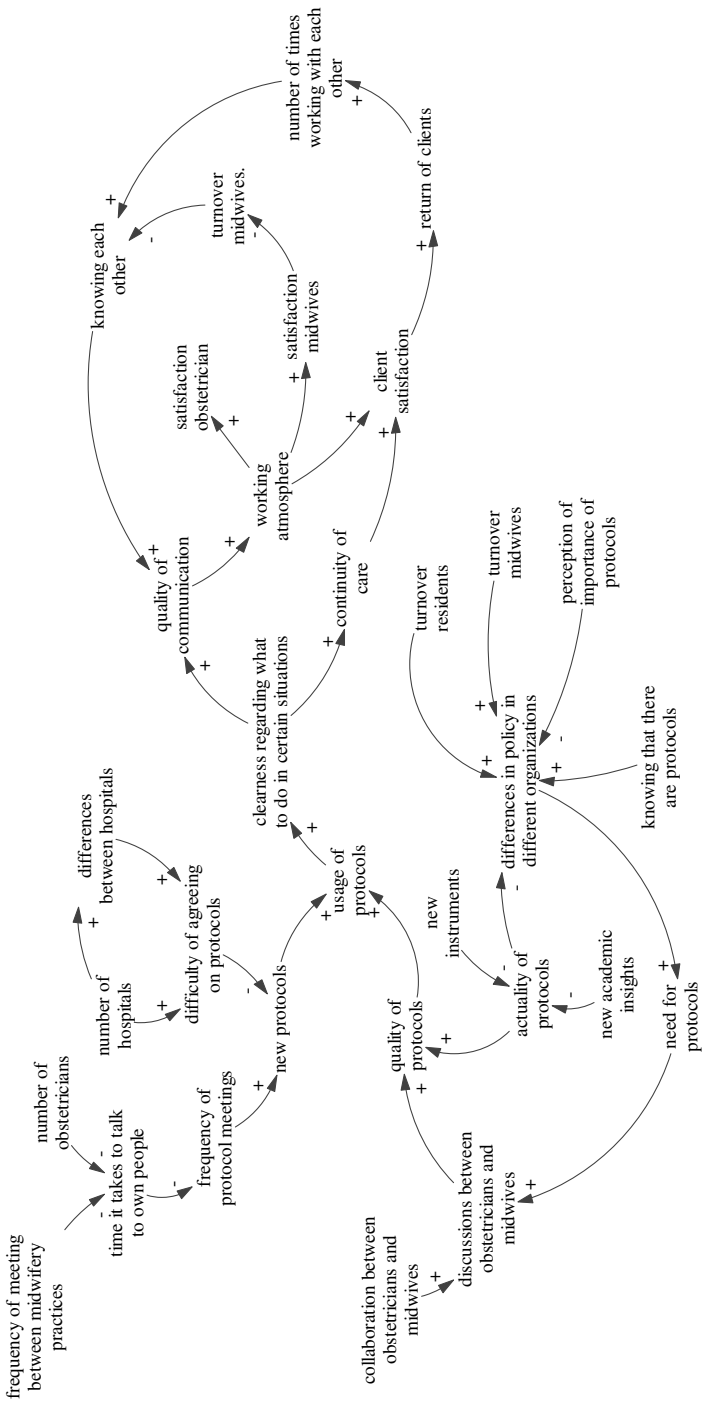


Figure C-3 Consequences of using protocols (by midwifery practice)

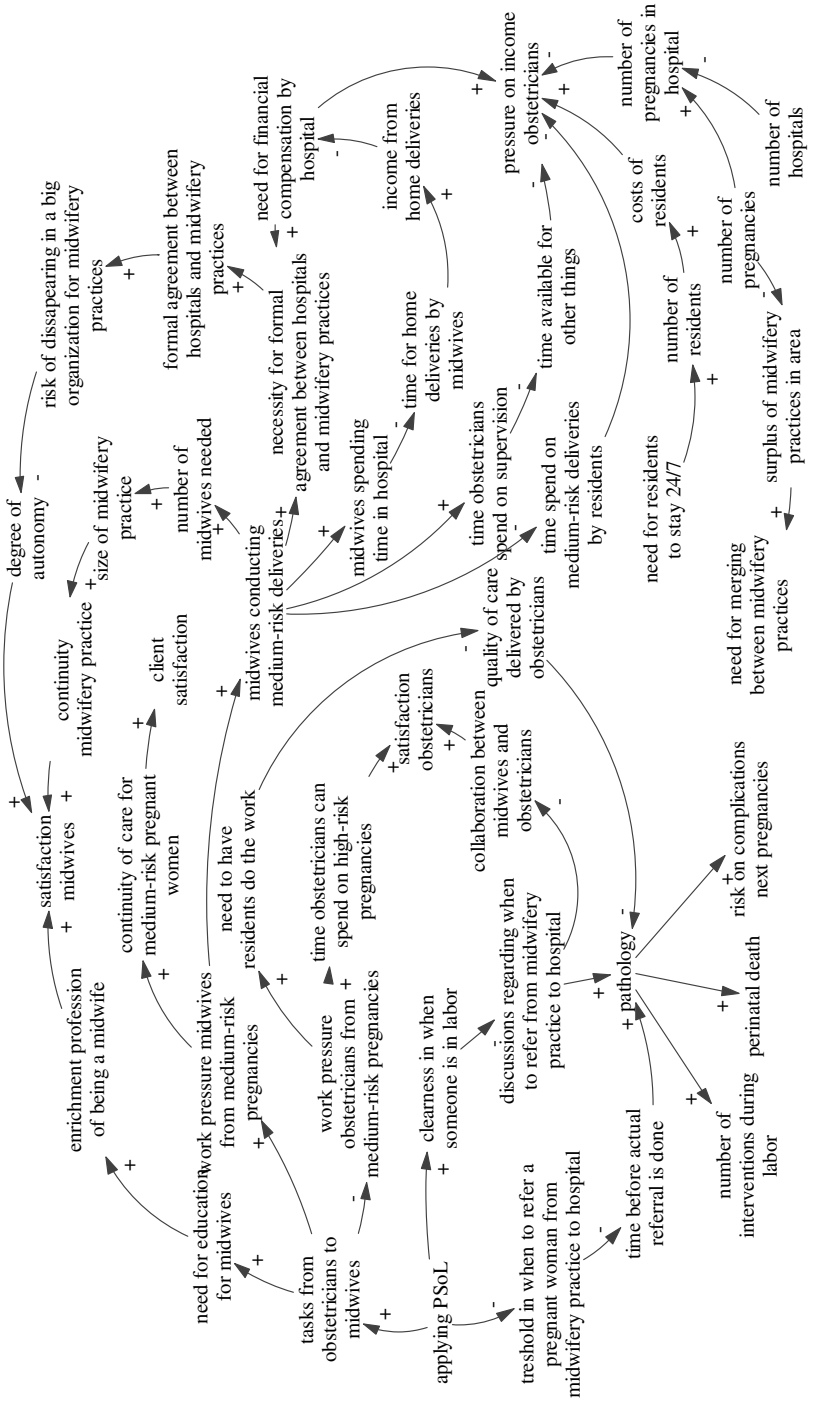


Figure C-4 Having a shared vision: Preventive Support of Labour (PSoL) (by midwifery practice)

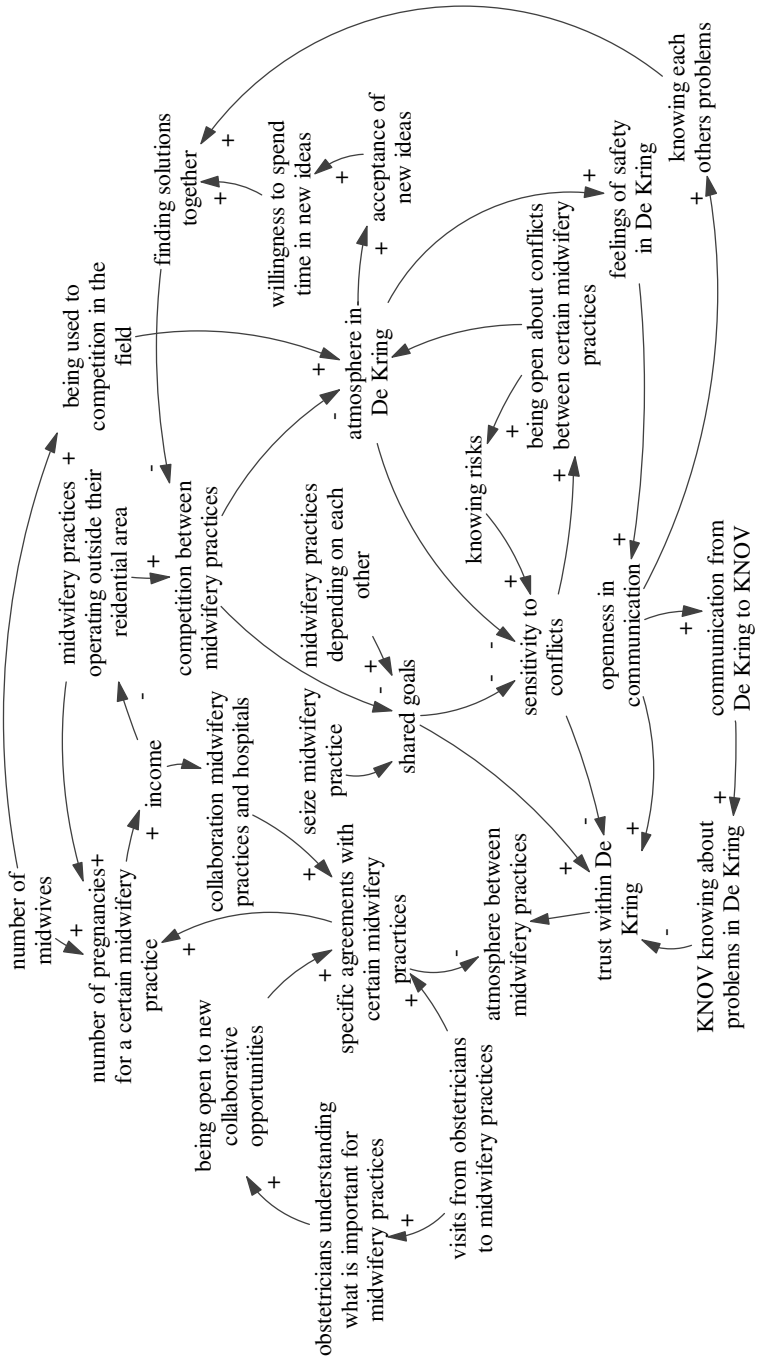


Figure C-5 Performance of De Kring (by midwifery practice)

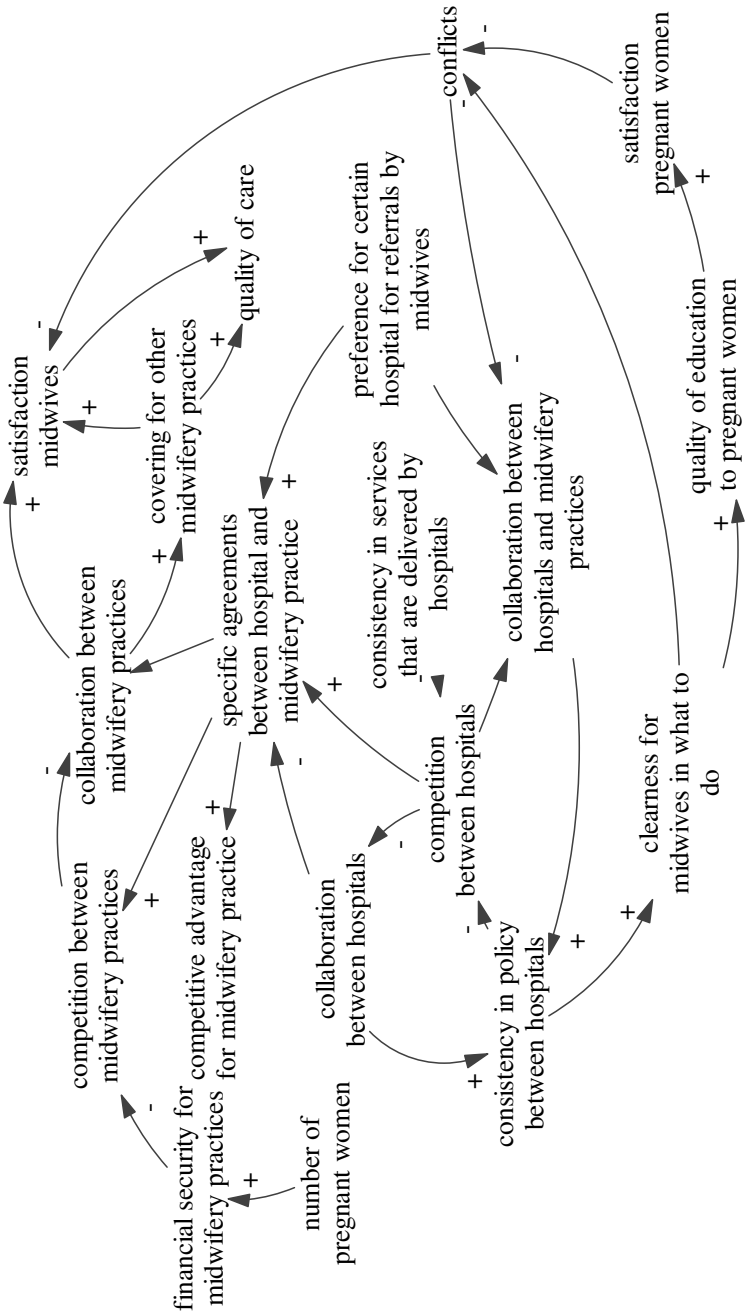


Figure C-6 Collaboration and competition between midwifery practices (by midwifery practice)

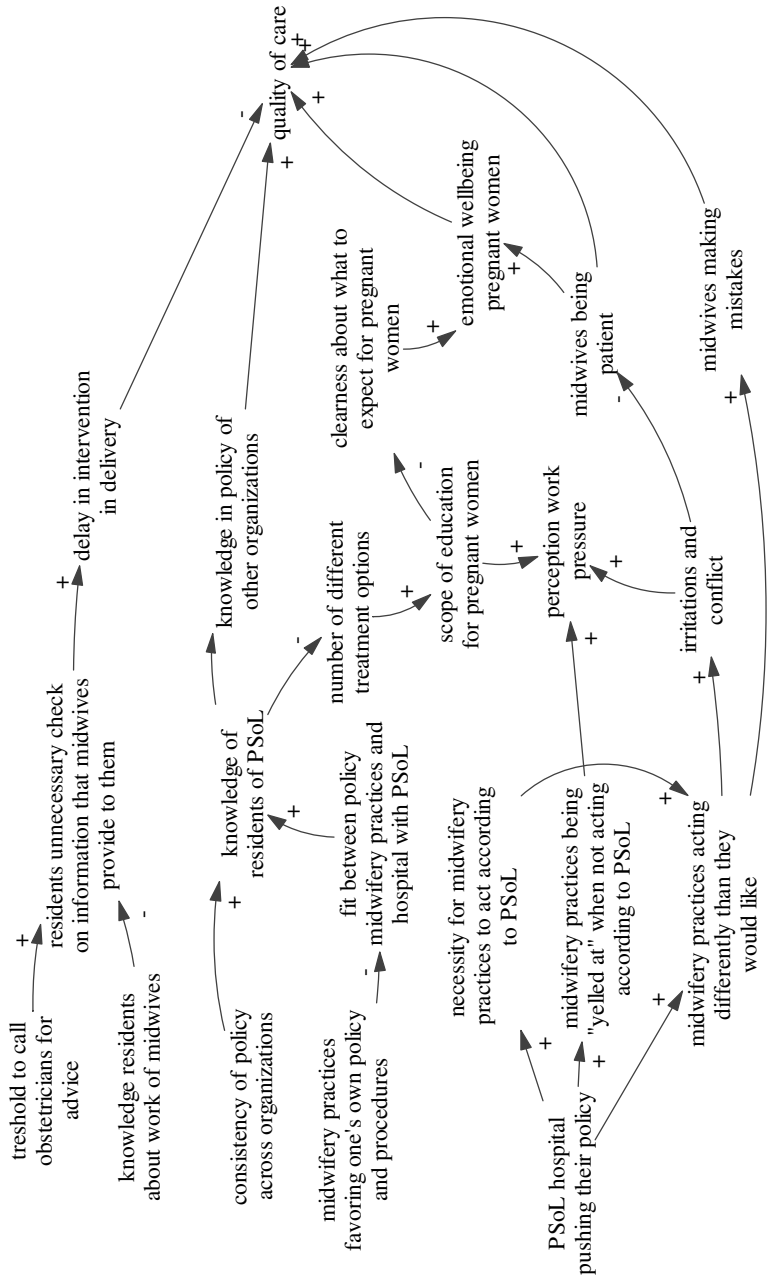


Figure C-7 Consequences of having one hospital that works according Preventive Support of Labor (PSoL) (by midwifery practice)

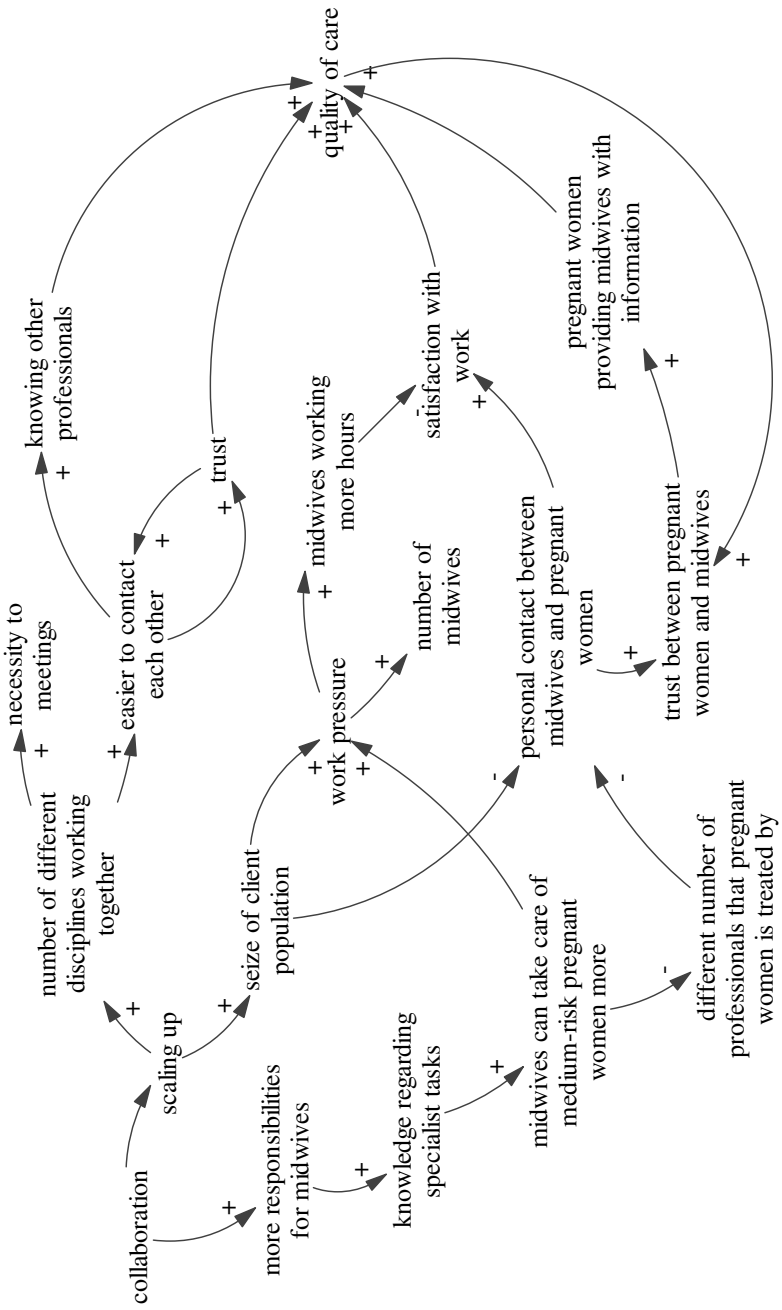


Figure C-8 When collaboration implies scaling up (by midwifery practice)

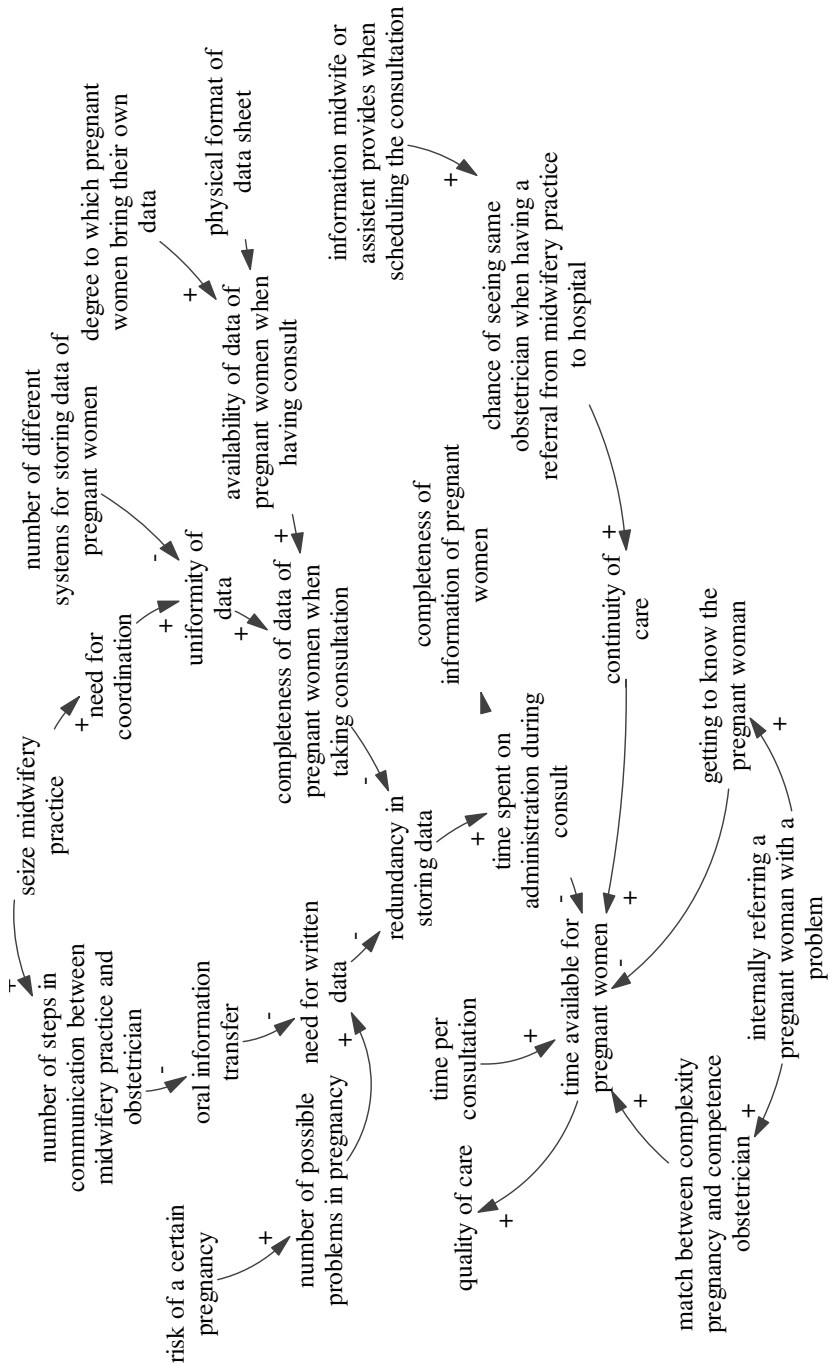


Figure C-9 Time for pregnant women (by obstetricians)

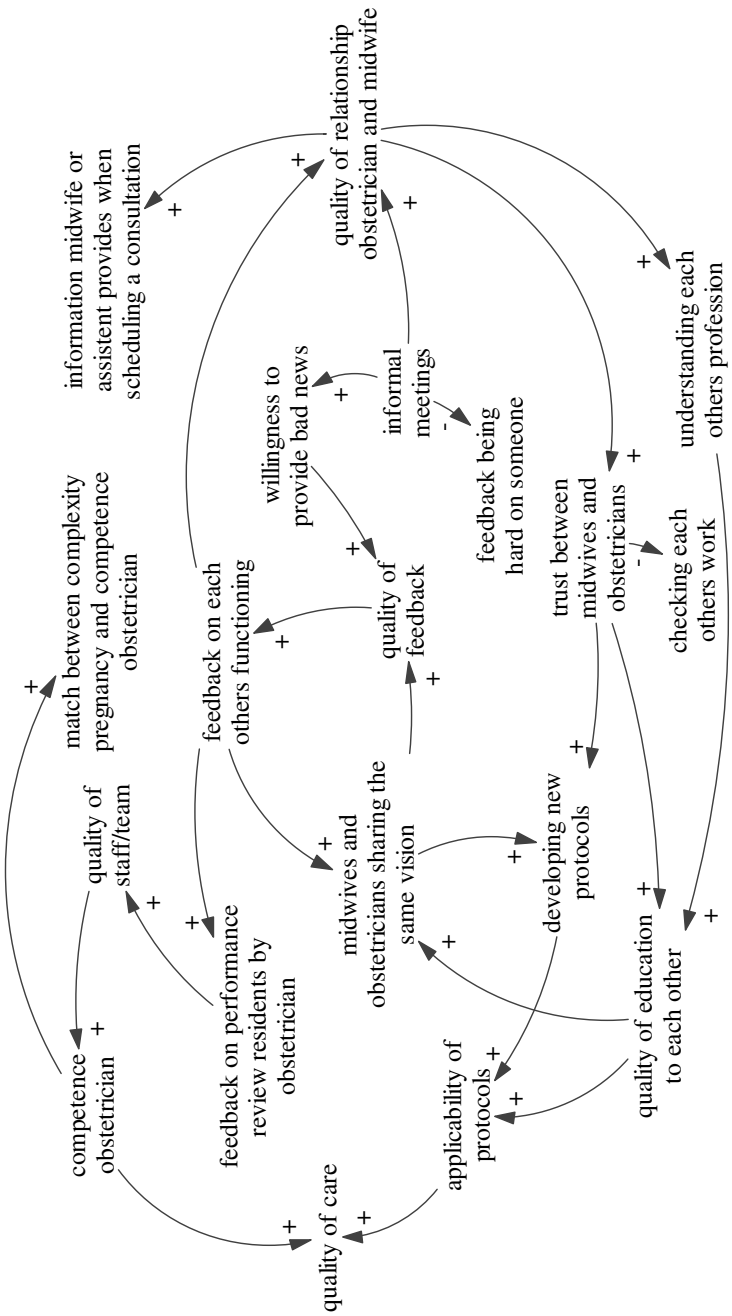


Figure C-10 Relationship between midwives and obstetricians (by obstetricians)

Appendix D

Improvement Proposals

Appendix D. Improvement Proposals

In this appendix the different improvement proposals are presented. The proposals are described with the following variables:

- Description: a general description of the improvement proposal
- Level of collaboration: High, medium or low collaboration
- Phase in the pregnancy: ante partum, durante partu or post partum
- Problems that are being solved
- Unwanted consequences
- Hypothesis why the improvement should work
- Required conditions
- Relation with other improvements
- Expected advantage for actors involved (+, ++ = positive; 0 = neutral; -, -- = negative)
- Level of commitment needed from actors involved (1 = no commitment needed; 5 = full commitment needed)

In total twenty proposals have been formulated for twelve subjects. For example, there are three proposals regarding the prenatal diagnostics, each with a different level of collaboration. The proposals are:

- Joint intake
- 2a-2b-2c. Prenatal diagnostics
- 3a-3b-3c. ECHO
- 4a-4b. Discussion of pregnant women
- 5a-5b. Central electronic medical record
- 6a. Nurse consulting hours
- 6b. Room for general information
- Joint education
- Room for midwives in the hospital
- Central on-call system
- 10a-10b. Reception women in labor
- Referral while in partu
- Overnight stay after delivery

1. Joint intake	
Description	All pregnant women receive an intake, attended by one midwife and one obstetrician. Together they will decide on a care path. Topics include: term echo, medical intake, information on prenatal diagnostics.
Level of collaboration	High
Phase in pregnancy	Ante partum
Problems that are being solved	- Tuning problems between midwives and obstetricians - Different policies regarding care process between midwives and obstetricians - Deciding on the risk level of a pregnant women takes a lot of time now, with both consultations by the midwife and obstetrician
Unwanted consequences	A pregnant women that only requires care from obstetricians or care from midwives is now been seen by both midwives and obstetricians
Hypothesis why it should work	- Better agreements at the start → less tuning problems later on - Better agreements at the start → more unity in policy - Deciding on the risk level together → faster deciding on the risk level
Required conditions	- The midwife as well as the obstetrician has to be able to claim expenses of the intake - Sufficient room for consultations - Obstetrician has to be able to deal with providing care to low-risk pregnant women
Relation with other improvements	2a – 3 – 4
Expected advantages for	Pregnant women: ++ Midwife: + Obstetrician: + Resident: + Care process: + Quality of care: +
Level of commitment needed from	Obstetrician: 5 Midwife: 5 Pregnant women: 2 Management hospital: 4

2a. Prenatal diagnostics: Joint intake	
Description	The provision of information on the prenatal diagnostics will be given in the joint intake. In addition, the discussion of the prenatal diagnostics will be centrally, by a specialized team.
Level of collaboration	High
Phase in pregnancy	Ante partum

Problems that are being solved	- Explaining prenatal diagnostics is very hard - There is often not enough time in a regular consult to discuss prenatal diagnostics
Unwanted consequences	Midwives currently receive some money (25 euro) for discussing the result of prenatal diagnostics. There will be a loss of income for midwives.
Hypothesis why it should work	Unambiguous information → less confusion for pregnant women & working more efficient
Required conditions	Location
Relation with other improvements	1
Expected advantages for	Pregnant women: + Midwife: + Obstetrician: + Resident: + Care process: + Quality of care: +
Level of commitment needed from	Obstetrician: 4 Midwife: 4 Pregnant women: 2 Management hospital: 2

2b. Prenatal diagnostics: Education	
Description	Providing training in effective communication about prenatal diagnostics. Developing scripts. Providing training with new developments.
Level of collaboration	Medium
Phase in pregnancy	Ante partum
Problems that are being solved	Information regarding prenatal diagnostics is not consistent throughout midwifery practices and hospitals.
Unwanted consequences	Midwives are being stimulated to keep on working on their own, instead of in an integrated care center
Hypothesis why it should work	Good education → better quality in providing information to pregnant women
Required conditions	n/a
Relation with other improvements	n/a
Expected advantages for	Pregnant women: + Midwife: + Obstetrician: + Resident: n/a Care process: + Quality of care: +

Level of commitment needed from	Obstetrician: 5 Midwife: 5 Pregnant women: 1 Management hospital: 2

2c. Prenatal diagnostics: Joint information material	
Description	Development of information material about prenatal diagnostics that will be used by midwives and obstetricians.
Level of collaboration	Low
Phase in pregnancy	Ante partum
Problems that are being solved	Information regarding prenatal diagnostics is not consistent throughout midwifery practices and hospitals
Unwanted consequences	n/a
Hypothesis why it should work	Uniform information material → unity and clarity for pregnant women
Required conditions	n/a
Relation with other improvements	n/a
Expected advantages for	Pregnant women: + Midwife: + Obstetrician: + Resident: 0 Care process: + Quality of care: 0
Level of commitment needed from	Obstetrician: 5 Midwife: 4 Pregnant women: 1 Management hospital: 1

3a. ECHO: Direct echo-expertise	
Description	All consultations of the midwife will take place at the hospital. Whenever an echo is needed, there is always one available. The pregnant woman does not have to make a separate appointment and an obstetrician is available in case of any problems.
Level of collaboration	High
Phase in pregnancy	Ante partum
Problems that are being solved	- Pregnant women do not have to make an appointment for a new visit in the hospital. - Pregnant women have results directly.

Unwanted consequences	It will be very easy to ask for an echo. More pregnant women will want to have one even when it is not necessarily needed. This will increase costs.
Hypothesis why it should work	- Direct availability of echo and expertise → higher quality of care & working more efficient - Centralization of processes → working more efficient
Required conditions	- Availability echo machines - Availability expertise - Flexible schedule of echo
Relation with other improvements	8
Expected advantages for	Pregnant women: ++ Midwife: + Obstetrician: + Resident: 0 Care process: + Quality of care: 0
Level of commitment needed from	Obstetrician: 5 Midwife: 5 Pregnant women: 4 Management hospital: 2

3b. ECHO: Education	
Description	Joint education about echo's. Everybody is able to use their own echo machines
Level of collaboration	Medium
Phase in pregnancy	Ante partum
Problems that are being solved	Quality of echo itself and of interpreting the results
Unwanted consequences	Midwives are stimulated not to join an integrated center
Hypothesis why it should work	- Good education → higher quality of care - Working according to the same procedures → higher quality of care
Required conditions	- Availability good teachers - Availability good courses
Relation with other improvements	n/a
Expected advantages for	Pregnant women: + Midwife: ++ Obstetrician: + Resident: + Care process: + Quality of care: +
Level of	Obstetrician: 2

commitment needed from	Midwife: 5 Pregnant women: 1 Management hospital: 1

3c. ECHO: Shared facilities	
Description	All midwifery practices are allowed to use the echo in the hospital
Level of collaboration	Low
Phase in pregnancy	Ante partum
Problems that are being solved	- Competition between midwifery practices (due to the fact that only one midwifery practice is allowed to do this) - More efficient use of resources
Unwanted consequences	- Current echo machines midwifery practices not needed any more - All pregnant women need to come to the hospital for echo
Hypothesis why it should work	Centralization → working more efficient
Required conditions	What about the expenses that midwives can claim for making an echo when they are using the ones form the hospital?
Relation with other improvements	8
Expected advantages for	Pregnant women: + Midwife: + Obstetrician: + Resident: 0 Care process: ++ Quality of care: +
Level of commitment needed from	Obstetrician: 5 Midwife: 5 Pregnant women: 3 Management hospital: 4

4a. Discussion of all pregnant women	
Description	Weekly discussion of all pregnant women in the care process. Obstetricians, midwives and residents have to attend
Level of collaboration	High
Phase in pregnancy	Ante partum
Problems that are being solved	- Knowledge level residents, midwives and obstetricians - Consistency in care policies - Trusting each other
Unwanted consequences	Time that it takes from obstetricians, midwives and residents

Hypothesis why it should work	- Discussion about care pathways and issues of pregnant women → understanding each other's actions → more trust in each other - Discussion about care pathways and issues of pregnant women → getting to know each other's beliefs - Making agreements together → consistency towards pregnant women
Required conditions	n/a
Relation with other improvements	1
Expected advantages for	Pregnant women: + Midwife: + Obstetrician: + Resident: ++ Care process: + Quality of care: 0
Level of commitment needed from	Obstetrician: 5 Midwife: 5 Pregnant women: 1 Management hospital: 1

4b. Discussion of pregnant women with a moderate risk (B-D)	
Description	Weekly discussion of all pregnant women with a moderate risk. Obstetricians, midwives and residents have to attend
Level of collaboration	Medium
Phase in pregnancy	Ante partum
Problems that are being solved	- Knowledge level residents, midwives and obstetricians - Increase in consistency in care policies increase in trust in each other - Increase in consistency in care policies
Unwanted consequences	Time that it takes from obstetricians, midwives and residents
Hypothesis why it should work	- Discussion about care pathways and issues of pregnant women → understanding each other's actions → more trust in each other - Discussion about care pathways and issues of pregnant women → getting to know each other's beliefs making agreements together → consistency towards pregnant women
Required conditions	n/a
Relation with other improvements	1

Expected advantages for	Pregnant women: 0 Midwife: + Obstetrician: + Resident: + Care process: + Quality of care: 0
Level of commitment needed from	Obstetrician: 5 Midwife: 5 Pregnant women: 1 Management hospital: 1

5a. Central electronic medical record	
Description	Development of one electronic medical record for all hospitals and all midwifery practices
Level of collaboration	High
Phase in pregnancy	Ante partum
Problems that are being solved	- Different professionals filling in the same information in different EMR's - Consultations from the obstetricians can be more efficient if, in case of a referral from the midwife, the information is already in the system - Pregnant women sometimes forget their information when being referred - In case of an emergency, all information is available
Unwanted consequences	n/a
Hypothesis why it should work	One database → working more efficient & access to the latest information
Required conditions	- Security personal data - Integration with other facilities from the hospital (lab, echo etcetera)
Relation with other improvements	n/a
Expected advantages for	Pregnant women: + Midwife: ++ Obstetrician: ++ Resident: + Care process: ++ Quality of care: 0
Level of commitment needed from	Obstetrician: 4 Midwife: 4 Pregnant women: 1 Management hospital: 5

5b. Electronic medical record being visible for other professionals	
Description	Midwives will have access to the EMR from the hospitals and obstetricians will have access to the EMR of the midwifery practices. However, they cannot change or add data. Data can be transported by "cut and paste"
Level of collaboration	Medium
Phase in pregnancy	Ante partum
Problems that are being solved	- Different professionals filling in the same information in different EMR's - Consultations from the obstetrician can be more efficient if, in case of a referral from the midwife, the information can be accessed - Pregnant women sometimes forget their information when being referred - In case of an emergency, all information is available
Unwanted consequences	n/a
Hypothesis why it should work	- One database → working more efficient & access to the latest information - Electronic insight into information (instead of on paper) → faster putting information in own information system
Required conditions	Security personal data
Relation with other improvements	n/a
Expected advantages for	Pregnant women: + Midwife: + Obstetrician: + Resident: 0 Care process: + Quality of care: 0
Level of commitment needed from	Obstetrician: 4 Midwife: 4 Pregnant women: 1 Management hospital: 5

6a. Nurse consulting hours	
Description	Nurse consultations hours will be available where pregnant women can ask questions related to pregnancy and delivery, which do not necessary have to be answered by a midwife or an obstetrician. In addition, information meetings will be held in which a group of pregnant women will be educated at certain topics.
Level of collaboration	Medium
Phase in pregnancy	Ante partum

Problems that are being solved	- Information about everything related to pregnancy will be available - Having midwives and obstetricians concentrate on those things that they are specialized in
Unwanted consequences	n/a
Hypothesis why it should work	- Central information → higher change that information will represent actual procedures - Central information → pregnant women only receive information from one source - Central information → working more efficient
Required conditions	n/a
Relation with other improvements	n/a
Expected advantages for	Pregnant women: + Midwife: + Obstetrician: + Resident: 0 Care process: + Quality of care: +
Level of commitment needed from	Obstetrician: 2 Midwife: 3 Pregnant women: 2 Management hospital: 3

6b. Room for general information	
Description	A room will be available to midwives where they can have information meetings for their pregnant women
Level of collaboration	Low
Phase in pregnancy	Ante partum
Problems that are being solved	Not having different information evenings for each midwifery practice anymore
Unwanted consequences	Less personal contact with pregnant women
Hypothesis why it should work	n/a
Required conditions	- One has to be able to provide good information - Publicity
Relation with other improvements	n/a

Expected advantages for	Pregnant women: + Midwife: + Obstetrician: + Resident: 0 Care process: + Quality of care: +
Level of commitment needed from	Obstetrician: 4 Midwife: 3 Pregnant women: 2 Management hospital: n/a

7. Joint education	
Description	- Having a joint educational program which will be attended by midwives, obstetricians and residents and which will be given by midwives, residents and obstetricians together. (Thus this will not be only obstetricians providing the others with their knowledge). - Having residents do an internship at a midwifery practice
Level of collaboration	Medium
Phase in pregnancy	Ante partum
Problems that are being solved	- Level of knowledge of the professionals - Understanding each other's actions
Unwanted consequences	Time
Hypothesis why it should work	- More knowledge → higher quality of care - Getting knowledge together → consistency in treatment → understanding and trust
Required conditions	n/a
Relation with other improvements	n/a
Expected advantages for	Pregnant women: 0 Midwife: + Obstetrician: + Resident: + Care process: + Quality of care: +
Level of commitment needed from	Obstetrician: 4 Midwife: 4 Pregnant women: 1 Management hospital: 2

8. Room for midwives in the hospital	
Description	Room will be available for midwives in the hospital for their regular consultations
Level of collaboration	Low
Phase in pregnancy	Ante partum
Problems that are being solved	Easy discussion with obstetricians and residents possible for midwives
Unwanted consequences	Too much discussion
Hypothesis why it should work	Being physical more close to each other → discussing things easier
Required conditions	Room needs to be available
Relation with other improvements	3
Expected advantages for	Pregnant women: 0/+ Midwife: 0/+ Obstetrician: - Resident: - Care process: 0/+ Quality of care: n/a
Level of commitment needed from	Obstetrician: 3 Midwife: 2 Pregnant women: 2 Management hospital: n/a

9. Central on-call system	
Description	There will be one phone number which has to be called by pregnant women when they are in labor
Level of collaboration	High
Phase in pregnancy	Durante partu
Problems that are being solved	Pregnant women have to call sometimes several numbers before they get hold of the person who can help
Unwanted consequences	Accessibility of phone number
Hypothesis why it should work	One number → easier and clearer for pregnant women
Required conditions	n/a
Relation with other improvements	A special “on duty system” has to be developed

Expected advantages for	Pregnant women: + Midwife: 0 Obstetrician: 0 Resident: 0 Care process: + Quality of care: 0
Level of commitment needed from	Obstetrician: 2 Midwife: 2 Pregnant women: 1 Management hospital: 2

10a. Reception women in labor 1	
Description	Pregnant women who are in partu are allowed to come to the hospital. The midwives will stop by every two hours and the pregnant women will be taken care of by a nurse.
Level of collaboration	High
Phase in pregnancy	Durante partu
Problems that are being solved	- Not being allowed to come to the hospital before a dilation of 7 cm - Pregnant women are more calm when they are allowed to come earlier during her delivery
Unwanted consequences	Midwives have to come to the hospital more often
Hypothesis why it should work	Being at the intended place of delivery earlier → pregnant women more calm & more value for client
Required conditions	n/a
Relation with other improvements	n/a
Expected advantages for	Pregnant women: ++ Midwife: +/++ Obstetrician: 0 Resident: 0 Care process: ++ Quality of care: ++
Level of commitment needed from	Obstetrician: 4 Midwife: 4/5 Pregnant women: 1 Management hospital: 4

10b. Reception women in labor 2	
Description	Pregnant women who are in partu are allowed to come to the hospital. The midwife will stop by every three hours and the pregnant women will be taken care of by a nurse.
Level of collaboration	Medium
Phase in pregnancy	Durante partu
Problems that are being solved	- Not being allowed to come to the hospital before a dilation of 7 cm - Pregnant women is more calm when she is allowed to come earlier during her delivery
Unwanted consequences	n/a
Hypothesis why it should work	Being at the intended place of delivery earlier → pregnant women are more calm & more value for client
Required conditions	n/a
Relation with other improvements	n/a
Expected advantages for	Pregnant women: + Midwife: + Obstetrician: ++ Resident: + Care process: ++ Quality of care: ++
Level of commitment needed from	Obstetrician: 4 Midwife: 3/4 Pregnant women: 1 Management hospital: 4

11. Referral while in partu	
Description	Referral of pregnant women in partu takes place later than is currently the norm. Midwives will have extra training so they are able to perform more special actions and so they have more responsibilities. Obstetrician will still have end responsibility.
Level of collaboration	High
Phase in pregnancy	Durante partu
Problems that are being solved	- Midwives can help their clients for a longer period - Communication and trusting problems between residents/obstetricians and midwives will decrease - Obstetricians can concentrate on the more specialist work - Work will be more challenging for midwives - Less residents are needed and thus better quality
Unwanted consequences	- It should be clear which actions midwives are allowed to do - Less education opportunities for residents

Hypothesis why it should work	There is no medical reason why midwives cannot perform more complicated tasks, and having less changes of staff during a delivery will improve quality of care
Required conditions	- Knowledge level of midwives has to be increased - What about the financial compensation for midwives
Relation with other improvements	n/a
Expected advantages for	Pregnant women: + Midwife: + Obstetrician: + Resident: 0 Care process: + Quality of care: 0
Level of commitment needed from	Obstetrician: 4 Midwife: 5 Pregnant women: 1 Management hospital: 3

12. Overnight stay after delivery	
Description	Women who just delivered in the hospital will have the opportunity to stay the night (currently they have to leave the hospital after four hours)
Level of collaboration	Low
Phase in pregnancy	Post partum
Problems that are being solved	It is not really nice to clients when they have to leave in the middle of the night
Unwanted consequences	What about when it is really busy?
Hypothesis why it should work	Option to spend the night → higher value for the client
Required conditions	n/a
Relation with other improvements	n/a
Expected advantages for	Pregnant women: +/++ Midwife: 0 Obstetrician: 0 Resident: 0 Care process: + Quality of care: 0
Level of commitment needed from	Obstetrician: 1 Midwife: 1 Pregnant women: 1 Management hospital: 4

Appendix E

Task Forces

Appendix E. Task Forces

In total, eight different improvement proposals are being implemented by task forces. This appendix provides an overview of the task forces. For each the following is described:

- Description of the improvement
- Problems that are being solved
- The status quo of the developments of the task force after one year (December 2007)
- Plans regarding follow up in the next year (2008)

In addition to the improvement proposals that have been formulated before, some additional topics were added on one of the plenary meetings: pre-conceptual consultations, suspicion of abuse and collaboration with pediatrics.

In total, the following task forces are discerned:

- Development of electronic medical record
- Joint education
- Discussion of pregnant women with a moderate risk (B-D)
- Prenatal diagnostics
- Pre-conceptual consultations
- Suspicion of abuse
- Uniform information material
- Collaboration with pediatrics

1. Development of electronic medical record	
Description	Stimulating the development of an electronic medical record system that will be used by the two hospitals and the twelve midwifery practices
Problems that are being solved	- Different professionals filling in the same information in different EMR's - Consultations from the obstetricians can be more efficient if, in case of a referral from the midwives, the information is already in the system - Pregnant women sometimes forget their information when being referred - In case of an emergency, all information is available
Status Quo December 2007	- In February a lean workshop has been organized to display the care process and the information flows. - In March, it was decided that Medicinfo is going to develop the EMR. - A first version of a web-based electronic medical record has been delivered in December. - In January the first version is demonstrated to midwives and obstetricians. They are exited.
Follow up	- For the obstetricians it is necessary that the EMR can exchange data with the hospital systems. - Extra money is applied for.

2. Joint education	
Description	Having a joint educational program which will be attended by midwives, obstetricians and residents and which will be given by midwives, residents and obstetricians together. (Thus this will not be only obstetricians providing the others with their knowledge).
Problems that are being solved	- Level of knowledge of the professionals - Understanding each other's actions

Status Quo December 2007	- Two meetings have been organized. They meetings consisted of a theoretical and a practical part. De attendees were assigned to groups, consisting of midwives, obstetricians and residents. - They meetings were well attended and positive evaluated. - Accreditation for midwives by the KNOV is obtained.
Follow up	They will keep organizing these meetings, probably twice per year.

3. Discussion of pregnant women with a moderate risk (B-D)	
Description	Weekly discussion of all pregnant women with a moderate risk. Obstetricians, midwives and residents have to attend.
Problems that are being solved	- Knowledge level residents, midwives and obstetricians - Increase in consistency in care policies increase in trust in each other - Increase in consistency in care policies
Status Quo December 2007	- Weekly lunch meetings are organized, one week in one hospital, the other week in the other hospital - Aim was for obstetricians from both hospitals to attend, but this was hard to realize - About every meeting a representative from every midwifery practice attended the meeting - After six months, it was decided to have a bi-weekly meeting - Notes are being taken and new guidelines and protocols will be developed based on what is discussed
Follow up	They will keep on doing this in the future

4. Prenatal diagnostics	
Description	Having a standard procedure around prenatal screening, which just has been made available for all pregnant women instead of for those over 36 years.
Problems that are being solved	- Preventing ambiguities in prenatal screening - Midwives are allowed to do the consultations, but the hospital will do the examinations; there has to be good collaboration between both so the right information is provided to the pregnant women.
Status Quo December 2007	- One central license for the whole region is apparently not advisable. - Four times a year a casuistic meeting is organized (accreditation is obtained by the KNOV) - A schedule is in place for midwives to attend the specialist in the hospital to spend a day with them to learn
Follow up	Every midwifery practice has to apply for a license by themselves

5. Pre-conceptual consultations	
Description	Having shared pre-conceptual consultations, organized by midwives and obstetricians
Problems that are being solved	- Preventing problems to happen during pregnancy by screening and providing information to pregnant women - Preventing that different midwifery practices and hospitals in the city will start their own pre-conceptual consultations which might result in coordination problems later on
Status Quo December 2007	- Preparations for a bi-weekly afternoon of sessions are done. General practitioners and pharmacies are provided with information. Discussion meetings between the midwives and obstetricians will be held bi-weekly.

Follow up	- Consultations are held in one hospital and at another location in the city. - "Mothers for mothers" is approached for financing, because insurance does not cover. (A non-profit organization that collects urine from pregnant women to extract hormones (humaan chorion gonadotrofine)).

6. Suspicion of abuse	
Description	Designing structures by which different professionals (child services, midwives, obstetricians, maternity care) can contact each other easily in case of a suspect of abuse in a family
Problems that are being solved	- Relevant information about problematic families gets lost or not transferred to other professionals - Professionals sometimes do not know what to do in case they are confronted with a family with problems
Status Quo December 2007	A structure is set in place so maternity services and midwives can communicate better
Follow up	Other organizations will be involved: AMK, centrum Jeugd & Gezin, Kinderbescherming (Child services)

7. Uniform information material	
Description	Designing guidelines which prescribe when pregnant women get which information.
Problems that are being solved	- Consistent and unambiguous information will be provided by all professionals - Making sure that pregnant women who are transferred from one care provider to another, receive all information
Status Quo December 2007	- All information that pregnant women receive is collected - An internet address is registered so there will be one portal
Follow up	Will keep on doing the work

8. Collaboration with paediatrics	
Description	Improving communication between midwives and pediatricians
Problems that are being solved	Midwives and pediatricians do not communicate well, which is important when women are at home after giving birth and the baby needs special care.
Status Quo December 2007	- Several guidelines are developed - Pediatricians will be involved in casuistic meetings and in the educational program, to provide a topic every year
Follow up	Midwives and pediatricians communicate better

Appendix F

Model Documentation

Appendix F. Model Documentation

This appendix presents the model documentation. The model documentation consists of the following sections:

1. Abbreviations
2. Additional details of the model and the scenarios
3. Various modeling considerations
4. Model assessment
5. Sensitivity analysis
6. Model documentation

The Systems Dynamic Review has defined a standard way of describing and explaining model structure (Martinez-Moyano, 2012). The model assessment and the model documentation are presented in line with this.

1. Abbreviations

Table F-1 Abbreviations used in the model and/or model documentation

Abbreviation	Description
%HR	percentage high-risk pregnant women in the system
$\%HR_{mp}$	percentage high-risk pregnant women that is being cared for in the wrong organization (midwifery practice)
AT	adjustment time
BCV	base case value
C	change
FCO	formal collaboration
H's	hospitals
HR	high-risk
$HR_{MP \rightarrow H}$	high-risk pregnant women from midwifery practices to hospitals
iv	initial value
LR	low-risk
$LR_{H \rightarrow MP}$	low-risk pregnant women from hospitals to midwifery practices
MP's	midwifery practices
PW	pregnant women
QoC	quality of care
S	scenario
SA	sensitivity analysis
TR	trust
$TR_{H \rightarrow MP}$	trust hospitals have in midwifery practices
$TR_{MP \rightarrow H}$	trust that midwifery practices have in hospitals
TfE	table for effect
WP	work pressure

2. Additional Details of the Model and the Scenarios

Collaboration and trust

FCO (formal collaboration) and TR (trust) have an effect on the same variables: on the referral percentages between the two types of organizations, on the QoC (quality of care) of the two organizations, and on the degree to which organizations outsource consultations. The effects of FCO and TR are linked together by the degree to which FCO is voluntary.

The structure to calculate the effect of FCO and TR is illustrated below with the first effect, that of the referral percentages (Figure F-1). Note that in the model there are two referral percentages, the referral percentage of low-risk pregnant women from hospitals to midwifery practices ($LR_{H \rightarrow MP}$) and the referral percentage of high-risk pregnant women from midwifery practices to hospitals ($HR_{MP \rightarrow H}$). The structure for both referral percentages is the same, although $LR_{H \rightarrow MP}$ is based on $TR_{H \rightarrow MP}$ and $HR_{MP \rightarrow H}$ is based on $TR_{MP \rightarrow H}$.

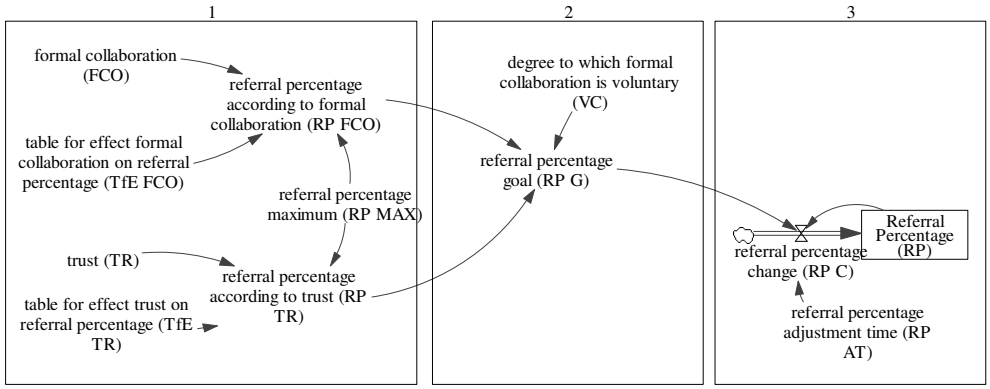


Figure F-1 Effect formal collaboration and trust on referral percentage

Firstly, the referral percentages based on the level of FCO and based on the level of TR are calculated.

*RP FCO = TfE FCO (FCO) * RP MAX*

*RP TR = TfE TR (TR) * RP MAX*

Secondly, the goal of the referral percentage is based on the referral percentage according to FCO, the referral percentage according to TR, and the degree to which the FCO is voluntary. This goal, RP G is a weighted average of the RP TR and the RP FCO: the higher the degree to which FCO is voluntary, the more weight is given to TR; and the lower the degree to which FCO is voluntary, the more weight is given to FCO. However, when the RP TR is higher than the referral percentage based on the weighted average, RP TR is leading. The reason for this is that trust outweighs the net result of FCO and TR: even when the net result is low, when trust is high, the organizations will collaborate, even though it is not officially formalized.

*RP G = max (VC * RP TR + (1 – VC) * RP FCO, RP TR)*

Thirdly, the actual referral percentage (stock) is adjusted based on the RP G, the previous referral percentage and the time it takes to adjust the stock to the new level.

RP C = (RP G – RP)/RP AT

The other effects of FCO are calculated in the same way.

Effects of trust

TR has three effects. For the first effect, that on the referral percentages between the two types of organizations, an "individual form" of trust is used: for the percentage $LR_{H \rightarrow MP}$ the $TR_{H \rightarrow MP}$ is used and for the percentage $HR_{MP \rightarrow H}$ the $TR_{MP \rightarrow H}$ is used. The percentage of PW that one organization is willing to refer to the other organization depends on the level of their own trust in the other organization.

However, for the other two effects (the effect on the QoC and the effect on the degree to which outsourcing of consultations takes place) a more "collective form" of trust is used:

$$Min(TR_{MP \rightarrow H}, TR_{H \rightarrow MP})$$

The reason behind this is that for TR to have an impact on the QoC and on the degree of outsourcing, both organizations have to trust each other. The degree of the effect is determined by the common level of trust in the system, i.e. the minimum of $TR_{MP \rightarrow H}$ and $TR_{H \rightarrow MP}$.

Quality of care

QoC is modeled for both MP's and H's. The structure presented below is equivalent for both types of organizations (Figure F-2).

First, the maximum QoC is calculated. The desired maximum QoC is determined by the degree to which consultations are outsourced to the other organization and by the assumptions made in the scenarios. The maximum QoC is calculated by the following:

QoC max D = if then(scenario in place, QoC max D S, TfE DoO (DoO))

QoC max C = (QoC max C – QoC max)/QoC max AT

Second, formal collaboration and trust determine the quality of care that will be delivered. Note that the minimum level of trust in the system is used (see above). The maximum QoC that an organization can deliver is decreased by the degree to which organizations collaborate and trust each other. Less trust and less formal collaboration makes the organizations deliver less QoC. The degree to which trust and formal collaboration have an effect is determined by the voluntariness of formal collaboration. When formal collaboration is voluntary, the QoC that will be delivered is mainly determined by the level of trust in the system. When formal collaboration is not voluntary, the QoC will be determined mainly by the level of formal collaboration in the system. However, when the

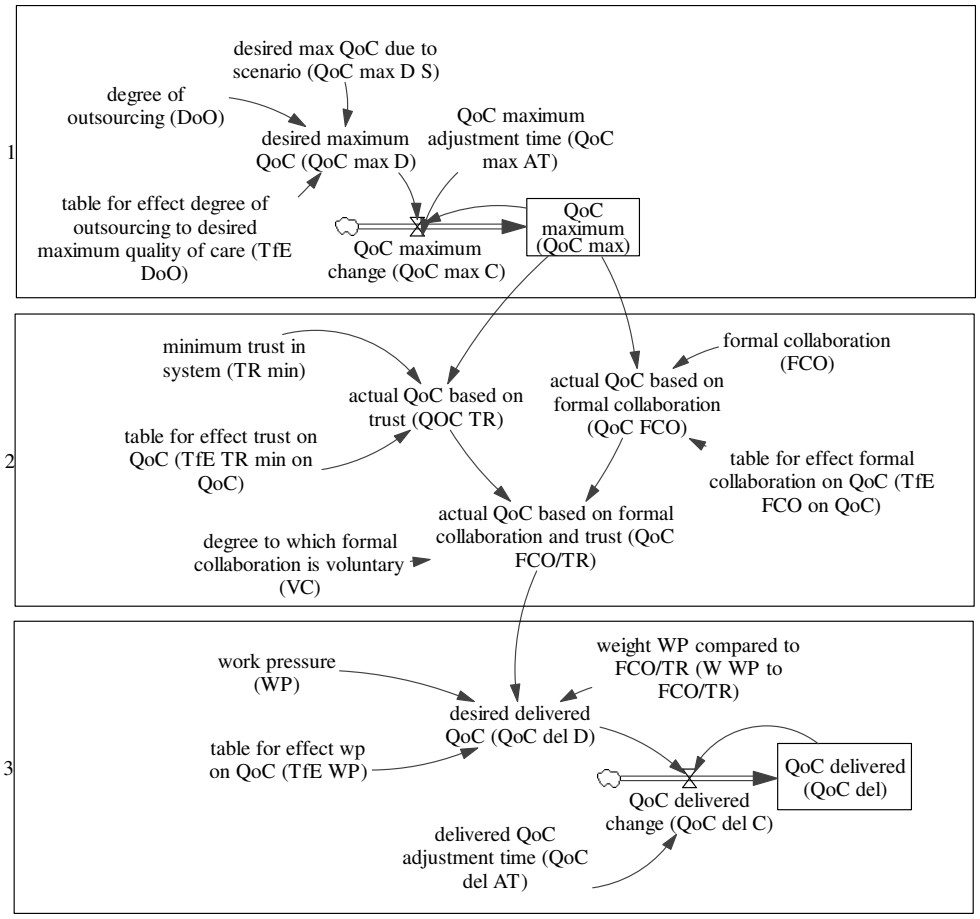


Figure F-2 Calculation of delivered quality of care

QoC because of trust is higher than the weighted average of both, trust prevails.

*QoC FCO = TfE FCO on QoC (FCO) * QoC max*

*QoC TR = TfE TR on QoC (TR) * QoC max*

*QoC FCO/TR = max (QoC TR, (1-VC) * QoC FCO + VC * QoC TR)*

Thirdly, the delivered quality of care is calculated, which is affected by the work pressure.

*QoC del D = W WP to FCO/TR * TfE WP (WP) * WP + (1 – W WP to FCO/TR) * QoC FCO/TR*

QoC del C = (QoC del D – QoC del)/QoC del AT

Integrated care model

In the integrated care model a certain percentage of MP's is integrated with the H's. Due to the fact that a certain percentage of MP's integrate with H's, some special adjustments are made in the model:

1. PW are moved from MP's to H's according to the percentage of MP's that integrate with the H's.
2. Staff is moved from MP's to H's according to the percentage of MP's that integrate with the H's.
3. The way PW present themselves to MP's and H's is changed according to the percentage of MP's that integrated with the H's.
4. $TR_{H \rightarrow MP}$ is based the following: the percentage HR_{MP} is compared to an acceptable level of HR_{MP}. When less PW are taken care of in MP's, this acceptable level also decreases. It will be linearly adjusted with the percentage of MP's that integrate with the H's. Note that no adjustments will be made the other way around: the acceptable level of LR_H will not change due to integration of MP's with H's.
5. CO and TR have an effect on QoC_H. These effects will be linearly adjusted to the percentage of MP's that integrate with H's. Imagine the following: if most MP's integrate with the H's, the collaboration of the H's with the small number of independent MP's that remain won't affect the QoC_H that much, because not much "business" will be done with them, for as the majority of PW are being taken care of in the H's. The same holds for the trust that H's have in MP's. Note that no adjustments will be made the other way around. MP's still depend on the CO with the H's and the level of trust of these independent MP's in the H's still affects their QoC in the same way as before.
6. The model uses t=10 and t=11 to adjust to these changes. During these twee weeks, regular dynamics in the model are put off, the changes are made, and on t=12, when everything is in place again, the dynamics of the model take over again.

3. Various Modeling Considerations

In every model, the modeler has to decide what to put in the model and what not to put in the model. Some of the considerations are given below. They are categorized by considerations regarding pregnant women and their behavior, regarding professionals, their behavior and the delivery of care, and some other considerations, for example regarding structures on a macro level.

Pregnant women

The model assumes that the behavior of pregnant women behavior does not change when the quality of care that organizations deliver change. One might argue that pregnant women might be attracted to the type of organization with the highest quality of care. However, due to the two-tiered structure in Dutch perinatal care, it is more or less prescribed that pregnant women presents themselves to the lowest type of care possible, i.e. midwifery practices in primary care. The high-risk pregnant women that present themselves to midwifery practices often do not know they have a high-risk, and the low-risk pregnant women that deliver themselves to the hospitals do not present themselves "out of the blue", they already have a history with the obstetric department. The behavior of how pregnant women present themselves to the organizations is therefore independent of the quality of care that the organizations actually deliver. And yes, pregnant women might present themselves to a different provider within a category (to a different midwifery practice or to a different hospital in the region), but the scope of this model (inter-organizational dynamics between types of care providers) does not allow for modeling individual midwifery practices and individual hospitals in a region.

Regarding the complications of pregnant women, the severity of complications is not modeled. One might argue that the lower the quality of care that is delivered, the worse the condition of the pregnant women and the higher the demand for services (in the extreme case pregnant women have to be held in the hospital for several days or weeks) or the higher the demand for different types of care (vaginal delivery versus caesarean section). One might argue that there is a gradual change in the degree of complications, with a different effect on the demand for care. Instead, only the number of pregnant women with a high-risk pregnancy is modeled (and thus not the severity of the complication) and the effect on the care process (the extra demand that the high-risks are generating) is modeled, thereby not making a distinction between different degrees of high-risk.

Although the satisfaction of pregnant women is modeled, the resulting behavior is not. One might expect that pregnant women will respond to changes in their satisfaction, for example, when pregnant women are not satisfied with the quality of care they have received, one might expect them to present themselves to another care provider instead, either during their current pregnancy or for upcoming ones. However, the model does not discern between individual midwifery practices and individual hospitals, since that is not the scope of the model. Therefore, when a pregnant women leaves a midwifery practice and turns to another one, this cannot be captured in the model, and is not necessary to be captured due to the focus on inter-organizational dynamics between hospitals and midwifery practices.

It is expected that there are no changes in preferences of pregnant women for either the midwifery practices or hospitals. In practice however, over the years a trend is emerging that pregnant women like to deliver in the hospital due to new technologies (for example availability of pain medication). Although this can be done under the supervision of a midwife from a midwifery practice, it might result in more pregnant women presenting themselves to hospitals at first.

Professionals and their behavior

One might argue that dynamics within organizations are of importance. For example the collaboration between midwives and obstetricians working in the hospital might have an effect on the quality of care that is delivered. However, the scope of the model is the inter-organizational level; we are interested in the dynamics between organizations and its effect on outcome. Modeling the dynamics within an organization or department is therefore too detailed.

Obstetricians and midwives offer different interventions to their patients, depending on the type of complications or the phase in the pregnancy. However, the model just captures "consultations" as a variable representing the demand that pregnant women put on the system. Individual procedures, such as vaginal delivery or caesarean section, are not modeled in detail. The scope of the model is the inter-organizational level; we are interested in the dynamics between organizations and its effect on outcome (i.e. the number of high-risk pregnant women). Modeling the different interventions that can be delivered within an organization or department is too detailed: a general construct that captures all demand (i.e. consultations) is abstract enough.

In the model hospitals and midwifery practices are modeled each as one identity. However, in a region there often are multiple hospitals and multiple midwifery practices. These actors each interact individually, which has an effect on overall collaboration between midwifery practices and hospitals. However, since we wanted to capture the essential dynamics regarding the inter-organizational dynamics between hospitals and midwifery practices, these interactions between midwifery practices themselves and between hospitals themselves are not captured in the model.

Referral behavior of professionals is determined in the model by the formal collaboration and by the level of trust. However, one could argue that referral behavior is also determined by the perceived competence that the referring organization has of the other. When obstetricians have a low perception of the competences of midwives, of the quality of care that midwives are delivering, they might decide to refer less low-risk pregnant women back to the midwifery practice. This behavior is not modeled explicitly. Instead, it is kind of modeled implicitly. For example, when the quality of care in midwifery practices drops,

more pregnant women will develop a high-risk pregnancy and since the trust that hospitals have in midwifery practices is determined by the number of high-risk pregnant women in midwifery practices, this trust decreases and as a result, hospitals will be less willing to refer low-risk pregnant women back to midwifery practices.

The model has not incorporated effects that new staff has on the model. In practice, new staff often has lower competences and new staff might result in a decrease in collaboration and trust; the professionals have to get to know each other, and it takes some time for new staff to understand all the local rules and procedures. This was modeled before but only added more detail to the model that is necessary.

Other

This model assumes a certain healthcare system. The healthcare system is organized the same throughout the Netherlands, which allows for a universal structure. In addition, the Netherlands hardly knows any competition in terms of quality or effectiveness, and although insurance companies have more and more a say in which treatments get refunded, they do not have any influence on what the level of collaboration between different organizations should be. As such, the model might be different for other healthcare systems.

4. Model Assessments

The Model Assessment section shows assessment results in three categories: model information, warnings, and potential omissions. This section allows modelers and model users to gain a better understanding of the basics of the model in terms of its elements and confidence-building tests (Martinez-Moyano, 2012).

Model Information

The model information can be found in Table F-2.

Table F-2 Model Information

Model Information	
Total Number of Variables	268
Total Number of State Varianles (Level+Smooth+Delay Variables)	27
Total Number of Stocks (Stocks in Level+Smooth+Delay Variables)	27
Total Number of Macros	0
Function Sensitivity Paramenter	0
Variables with Source Information	0

Data Lookup Tables	0
Time Unit	Week
Initial Time	0
Final Time	520
Reported Time Interval	Time Step
Time Step	1
Model is Fully Formatted	Yes
Modeler-Defined Groups	No
VPM File Available	No

Warnings

The warnings can be found in Table F-3. Some comments:

- Undocumented Equations
- Equations with Embedded Data. There are 74 equations with embedded data, these relate to one of the following situations:
    - Calculations regarding percentages, where sometimes the "(100-variable) variable" is needed.
    - Calculations regarding percentages, where a ratio (<1) is redefined to a percentage (between 0-100), by multiplication with 100.
    - Calculations with switches which can be on/off. If a switch is on, it has the value 1, if it is off, it has the value 0. Variables that depend on the switch are modeled with a "if then else (switch=0, … , …). This is the case with the built in scenarios.
    - Calculations regarding predefined effects of scenarios. For example, the improved hospital model has predefined that the percentage of pregnant women that is referred from hospitals to midwifery practices decreases to 0. As such, this is modeled explicitly.
- Non-monotonic Lookup Functions. There are 2 non-monotonic lookup functions. They refer to the outsourcing of consultations from hospital to midwifery practices or the other way around. The rationale behind this is as follows: When all consultations in the midwifery practice are conducted by the midwifery practice, the max quality of care of the midwifery practice is suboptimal because midwives lack cure competences. When all consultations in the midwifery practices are conducted by the hospital, then the max quality of care is also suboptimal because obstetricians lack care competences. Only when consultations are conducted by both organizations, a maximum quality of care is achieved.

- Equations with IF…THEN…ELSE. There are 36 equations with IF…THEN…ELSE. They all refer to changes made in the model in the different scenarios.
- Equations with MIN or MAX. There are 12 equations with MIN or MAX, these relate to one of the following situations:
    - Calculations regarding the effects of some scenarios.
    - Calculations regarding the effect of formal collaboration and trust. Formal collaboration and trust often together have an effect on other variables, with different weight given to each (by the voluntariness of the formal collaboration). However, when the effect of trust outweighs the effect of formal collaboration, the effect of trust prevails. See also Section 2 of this Appendix where collaboration and trust are discussed.
    - Calculations regarding "collective trust" in the system. See also Section 2 of this Appendix where the effects of trust are discussed.

Table F-3 Warnings

Warnings	
Undocumented Equations	213
Equations with Embedded Data	74
Equations With Unit Errors or Warnings	Unavailable
Variables not in Any View	0
Incompletely Defined Subscripted Variables	0
Non-monotonic Lookup Functions	2
Cascading (Chained) Lookup Functions	0
Equations with IF…THEN…ELSE	36
Equations with MIN or MAX	12

Potential Omissions

The potential omissions can be found in Table F-4. Some comments:

- Supplementary Variables. There are three supplementary variables, which are related to the performance indicators: percentage high-risk pregnant women, percentage high-risk pregnant women in hospitals, and percentage high-risk pregnant women in midwifery practices.
- Complex Variable Formulations. There are 28 complex variable formulations in the model. There are two generic causes of having formulations consisting of more than four variables:
    - The various scenarios are built in the model explicitly. Each scenario is put on with a switch, so the individual changes of the scenarios (see Table 7-1) do

not have to be done manually each time when running the model. This results in more complex formulations.

- The stocks of pregnant women have at least five in- or outflows: pregnant women entering the system, pregnant women flowing out of the system, pregnant women developing a complication, pregnant women recovering from a complication and pregnant women being referred between organizations.

Table F-4 Potential Omissions

Potential Omissions	
Unused Variables	0
Supplementary Variables	3
Supplementary Variables Being Used	0
Complex Variables (Richardson's Rule = 3)	28
Complex Stock Formulations	0

5. Sensitivity Analysis

This section describes the sensitivity analysis (SA) in detail. The following process is followed:

1. The individual scenarios (collaborative model, improved hospital model, and integrated care model) are tested to gain insight into the robustness of the outcomes. The tests can be categorized as follows:

    A. Tests regarding the *assumptions of the scenario*, thus regarding the changes that are made in the model when the scenario starts. For example, in the first scenario, the improved hospital model, the $\%LR_{H \rightarrow MP}$ changes to 0%. But what if it does not decrease to 0%?
    B. Test regarding *assumptions made in the model,* thus regarding direct effects of changes that are made in a scenario. For example, in the second scenario, the collaborative model, collaboration is increased. Collaboration has three direct effects: on the referral percentages, on the quality of care, and on the degree to which consultations are being outsourced. What if these variables are more or less responsive to changes in collaboration?
    C. Tests regarding *other relations and assumptions*. Thus these test assumptions made in the model.

2. For each individual scenario (collaborative model, improved hospital model, and integrated care model), the most important assumptions/variables/relations are defined. They are marked in the last column of Table F-5.
3. The combined scenarios (improved hospital + model and integrated care + model) are tested on those assumptions/variables/relations which appeared to have an effect in the individual scenarios of which the combined scenario is constructed. For example, for the improved hospital + model, where the improved hospital model and the collaborative model are combined, only the variables that have proven to have an effect in the improved hospital model and in the collaborative model, are tested. If necessary, some tests on variables are added or left out.
4. Overall, the most important assumptions/variables/relations are defined, based on both the individual and combined scenarios.
5. Finally, these most important ones are tested again against all five scenarios. The base scenarios have a particular order in how effective they are in terms of the performance indicators. When the most important assumptions/variables/relations are changed, does it change the comparative order of the scenarios? The following guidelines are applied.
    a. Only one assumption is changed per scenario. So no combinations of changing assumptions are tested.
    b. When an assumption is changed, it is changed for all scenarios.

Table F-5 provides an overview of the different sensitivity analyses that are conducted and what their results are in terms of the two main performance indicators: the percentage of high-risk pregnant women (%HR) and the percentage of high-risk pregnant women that is being taken care of by the wrong organization (i.e. midwifery practices) ($\%HR_{MP}$). "SA 2-3" refers to the third sensitivity test of the second scenario. "Test" refers to the category of tests as described above (A, B, C).

Table F-5 Overview sensitivity analysis (SA)

SA	description	test	%HR	$\%HR_{MP}$	important
Scenario 2: collaborative model					
2-1	intended level of FCO	A	+	+	*
2-2	duration of project	A	+	+	-
2-3	voluntariness of FCO	A	+	+	*
2-4	responsiveness $\%HR_{MP \rightarrow H}$ to FCO	B	+	+	*
2-5	responsiveness $\%LR_{H \rightarrow MP}$ to FCO	B	+	+	*
2-6	responsiveness QoC_{MP} to FCO	B	-	-	-
2-7	responsiveness QoC_{H} to FCO	B	-	-	-
2-8	responsiveness	B	+	-	*

	outsourcing MP to FCO				
2-9	responsiveness outsourcing H to FCO	B	-	-	-
Scenario 3: improved hospital model					
3-1	$\%LR_{H \rightarrow MP}$	A	-	-	-
3-2	maximum QoC_H	A	+	+	*
3-3	responsiveness $TR_{MP \rightarrow H}$ to LR_H	B	-	+	*
3-4	responsiveness $\%LR_H$ to HR_H to QoC_H	B	+	+	*
3-5	responsiveness $TR_{H \rightarrow MP}$ to HR_{MP}	C	-	-	-
Scenario 4: integrative care model					
4-1	percentage of integration	A	+	+	*
4-2	maximum QoC_H	A	+	+	*
4-3	$\%LR_{H \rightarrow MP}$	A	-	-	-
4-4	responsiveness $TR_{MP \rightarrow H}$ to LR_H	B	-	+	*
4-5	responsiveness $\%LR_H$ to HR_H to QoC_H	B	+	+	*
Scenario 5: improved hospital + model					
5-1	maximum QoC_H	A	+	+	*
5-2	intended level of FCO	A	+	+	*
5-3	voluntariness of FCO	A	+	+	*
5-4	responsiveness $\%HR_{MP \rightarrow H}$ to FCO	B	+	+	*
5-5	responsiveness $\%LR_{H \rightarrow MP}$ to FCO	B	-	+	*
5-6	responsiveness outsourcing MP to FCO	B	-	-	-
5-7	responsiveness outsourcing H to FCO	B	-	-	-
5-8	responsiveness $\%LR_H$ to HR_H to QoC_H	B	+	+	*
5-9	responsiveness $TR_{MP \rightarrow H}$ to LR_H	C	-	-	-
5-10	responsiveness $\%LR_{MP}$ to HR_{MP} to QoC_{MP}	C	+	-	*
5-11	responsiveness $TR_{H \rightarrow MP}$ to HR_{MP}	C	+	+	*
Scenario 6: integrative care + model					
6-1	percentage of	A	+	+	*

	integration				
6-2	maximum QoC_H	A	+	+	*
6-3	intended level of FCO	A	-	+	*
6-4	voluntariness of FCO	A	-	+	*
6-5	responsiveness $\%LR_H$ to HR_H to QoC_H	B	+	+	*
6-6	responsiveness $\%HR_{MP \rightarrow H}$ to FCO	B	-	+	*
6-7	responsiveness $\%LR_{H \rightarrow MP}$ to FCO	B	-	+	*
6-8	responsiveness outsourcing MP to FCO	B	-	-	-

- = outcome of scenario does not change

+ = outcome of scenario does change

* = important assumption/variable/relation

6. Model Documentation

Table F-6 presents the model documentation. The format is according to the standard of the System Dynamics Review (Martinez-Moyano, 2012). Regarding the abbreviations in the first column: the "A" refers to "auxiliary", the "C" to "constant", the "I" to "initial", the "F" to "flow", the "L" to "level", the "LI" to "level initial", and the "T" to "lookup".

Type	Variable Name and Description
C	% extra consultations h in h = 100
C	% extra consultations mp in mp = 25
A	% high-risk in mp of all women = pw hr mp/total women*100
A	% HR = (pw hr h+pw hr mp)/(pregnant women)*100
A	% HR in H = (pw hr h)/(pw hr h+pw hr mp)*100
A	% HR in MP = pw hr mp/(pw hr h+pw hr mp)*100
A	% hr presenting in h 2 = iv % hr presenting in h+change % hr presenting in h
A	% hr presenting in mp = IF THEN ELSE (Time=10,1-iv % hr presenting in h,0)

A	% low-risk in h of all women = pw lr h/total women*100
A	% lr presenting in mp 2 = iv % lr presenting in mp-change % lr presenting in mp
A	% lr presenting in mp on t tien = IF THEN ELSE (Time=10,iv % lr presenting in mp,0)
A	% midwifery practices that integrates with hospitals = IF THEN ELSE (S5: partly integrated care & collaborative model=1,0.2,0.2)
C	% pw hr to lr h = 10
C	% pw hr to lr mp = 15
L	% pw lr to hr h = ∫C % pw lr to hr h *dt* + [iv % pw lr to hr h]
L	% pw lr to hr mp = ∫C % pw lr to hr mp *dt* + [iv % pw lr to hr mp]
C	% pw presenting with hr = 15 Description: *22.7% presents themselves to secondary care(Stichting Perinatale Registratie Nederland, 2009. See also Chapter 4)48% of the pregnant women who present themselves at the hospital have a high-risk pregnancy at the start(See Chapter 5)An unknown percentage of the high-risk pregnancies will be presented in primary care*
L	% referral pw from h to mp = ∫C % referral pw from h to mp *dt* + [iv % referral pw from h to mp]
A	% referral pw from h to mp 2 = % referral pw from h to mp
L	% referral pw from mp to h = ∫C % referral pw mp to h *dt* + [iv % referral pw from mp to h]
A	% regular consultations h in h = 100-% regular consultations h in mp
L	% regular consultations h in mp = ∫C % regular consultations h in mp *dt* + [iv % regular consultations h in mp]
L	% regular consultations mp in h = ∫C % regular consultations mp in h *dt* + [iv % regular consultations mp in h]
A	% regular consultations mp in mp = 100-% regular consultations mp in h
A	acceptable % hr in mp = initial acceptable & hr in mp*correction (partly) integrated care 3
A	acceptable % lr in h

	= initial acceptable % lr in h
C	AT % consultations = 12
A	AT capacity h = IF THEN ELSE (S3: (partial) integrated care model 2=1 :AND: Time=11,temporarily adjustment AT capacity h integrated care,initial AT capacity h)
A	AT capacity mp = IF THEN ELSE (S3: (partial) integrated care model 2=1 :AND: (Time=11),temporarily adjustment AT capacity mp integrated care,initial AT capacity mp)
C	AT collaboration = 26
C	AT degree to which collaboration is voluntary = 12
C	AT delivered quality of care = 4
C	AT lr to hr = 4
C	AT max quality of care = 10
C	AT perceived work pressure = 1
C	AT refer from h to mp = 10
C	AT refer from mp to h = 4
C	AT referring pw = 12
C	AT trust = 16 Description: *Midwives only find out in aftercare whether or not a woman was correctly cared for by the hospital during her pregnancy. Also, obstetricians often find out during delivery whether or not a woman has been taken care of rightfully in primary care.*
F,A	C % pw lr to hr h = (goal % pw lr to hr h-% pw lr to hr h)/AT lr to hr
F,A	C % pw lr to hr mp = (goal % pw lr to hr mp-% pw lr to hr mp)/AT lr to hr

F,A	C % referral pw from h to mp = (goal referral from h to mp-% referral pw from h to mp)/AT referring pw
F,A	C % referral pw mp to h = (goal referral from mp to h-% referral pw from mp to h)/AT referring pw
F,A	C % regular consultations h in mp = IF THEN ELSE (correction for S4 en S5>=1,0,(goal % regular consultations h in mp-% regular consultations h in mp)/AT % consultations)
F,A	C % regular consultations mp in h = (goal % regular consultations mp in h-% regular consultations mp in h)/AT % consultations
F,A	C capacity B = (goal capacity h-capacity h)/AT capacity h
F,A	C capacity mp = (goal capacity mp-capacity mp)/AT capacity mp
F,A	C collaboration impuls = IF THEN ELSE (S on impuls collaboration 2=1 :AND: Time>=start intervention :AND: Time <= (start intervention+duration intervention),(goal collaboration S2 & S4-collaboration)/AT collaboration,0)
F,A	C degree to which collaboration is voluntarily = (goal degree to which collaboration is voluntary-degree to which collaboration is voluntary)/AT degree to which collaboration is voluntary
F,A	C max quality mp = (goal max quality of care mp-MAX quality of care mp)/AT max quality of care
F,A	C max quality of care h = (goal max quality of care h-MAX quality of care h)/AT max quality of care
F,A	C perceived work pressure h = (goal perceived work pressure h-perceived work pressure in h)/AT perceived work pressure
F,A	C perceived work pressure mp = (goal perceived work pressure mp-perceived work pressure in mp)/AT perceived work pressure
F,A	C quality of care h = (goal quality of care h-delivered quality of care h)/AT delivered quality of care

F,A	C quality of care mp = (goal quality of care mp-delivered quality of care mp)/AT delivered quality of care
F,A	C trust h in mp = (goal trust h in mp-trust h in mp)/AT trust
F,A	C trust mp in h = (goal trust A in B-trust mp in h)/AT trust
L	capacity h = ∫C capacity B dt + [iv capacity h calculated]
L	capacity mp = ∫C capacity mp dt + [iv capacity MP calculated]
L	change % hr presenting in h = ∫in dt + [iv change % hr presenting in h]
L	change % lr presenting in mp = ∫in 2 dt + [iv change % lr presenting in mp]
L	collaboration = ∫C collaboration impuls dt + [iv collaboration]
A	correction % referrals pw from h to mp due to scenario 1 = IF THEN ELSE (S1: improved hospital model 2=1 :OR: (S3: (partial) integrated care model 2=1 :AND: S5: partly integrated care & collaborative model 2=0), willingness to send lr pw from h to mp,1)
A	correction (partly) integrated care 3 = IF THEN ELSE (S3: (partial) integrated care model=1 :AND: Time>=12,(1-% midwifery practices that integrates with hospitals),1)
A	correction for (partly) integrated care 1 = IF THEN ELSE (S3: (partial) integrated care model=1 :AND: Time=11,0,1)
A	correction for (partly) integrated care 2 = IF THEN ELSE (S3: (partial) integrated care model 2=1 :AND: Time=11,0,1)
A	correction for S4 en S5 = MAX(S4: improved hospital model & collaborative model,S5: partly integrated care & collaborative model)
L	degree to which collaboration is voluntary = ∫C degree to which collaboration is voluntarily dt + [iv degree to which collaboration is voluntary]
L	delivered quality of care h = ∫C quality of care h dt + [iv quality of care h]
L	delivered quality of care mp = ∫C quality of care mp dt + [iv delivered quality of care mp]

C	duration intervention = 52
A	E collaboration on quality of care h = TfE collaboration on quality of care h (collaboration)
LI,I	E collaboration on quality of care h initial = INITIAL(E collaboration on quality of care h)
A	E collaboration on quality of care mp = TfE collaboration on quality of care mp (collaboration)
A	E quality of care h on % pw lr to hr h = TfE* quality of care h on % pw lr to hr h(delivered quality of care h)
A	E quality of care mp on % pw lr to hr mp = TfE* quality of care mp on % pw lr to hr mp(delivered quality of care mp)
A	E trust on quality of care h = TfE trust on quality of care h(min trust)
LI,I	E trust on quality of care h initial = INITIAL(E trust on quality of care h)
A	E trust on quality of care mp = TfE trust on quality of care mp(min trust)
A	E work pressure on quality of care h = TfE* perceived work pressure h on quality of care h(perceived work pressure in h)
A	E work pressure on quality of care mp = TfE* perceived work pressure mp on quality of care mp(perceived work pressure in mp)
L	effect S3 collaboration on quality of care = ∫in 10 dt + [E collaboration on quality of care h initial]
L	effect S3 trust on quality of care h = ∫in 9 dt + [E trust on quality of care h initial]
C	extra consultations for hr mp in h = 4 Description: *13 consultations are recommended(Heineman et al., 2004. See also Chapter 4)17 consultations are conducted in the hospital(See Chapter 5)*
A	extra consultations h in h = extra consultations in h for hr h*pw hr h*% extra consultations h in h/100
A	extra consultations h in mp = extra consultations in h for hr h*pw hr h*(100-% extra consultations h in h)/100
C	extra consultations in h for hr h = 4 Description: *13 consultations are recommended(Heineman et al., 2004. See also*

	Chapter 4)17 consultations are conducted in the hospital(See Chapter 5)
A	extra consultations mp in h = extra consultations for hr mp in h*pw hr mp*(100-% extra consultations mp in mp)/100
A	extra consultations mp in mp = extra consultations for hr mp in h*pw hr mp*% extra consultations mp in mp/100
F,A	from hr h to lr h = (% pw hr to lr h/100)*pw hr h/time recovering hr in h
F,A	from hr mp to lr mp = ((% pw hr to lr mp/100)*pw hr mp/time recovering hr in mp)*S5-2
F,A	from lr h to hr h = (% pw lr to hr h/100)*pw lr h/time developing hr in h
F,A	from lr mp to hr mp = ((% pw lr to hr mp/100)*pw lr mp/time developing hr in mp)*S5-2
A	goal % pw lr to hr h = MIN % lr to hr*E quality of care h on % pw lr to hr h
A	goal % pw lr to hr mp = MIN % lr to hr*E quality of care mp on % pw lr to hr mp
A	goal % regular consultations h in h due to collaboration = TfE collaboration on % consultations in h by h(collaboration)
A	goal % regular consultations h in h due to trust = TfE trust on % consultations h in h(min trust)
A	goal % regular consultations h in mp = MAX(goal % regular consultations h in mp due to trust,goal % regular consultations h in mp due to trust*degree to which collaboration is voluntary+(1-degree to which collaboration is voluntary)*goal % regular consultations h in mp due to collaboration)
A	goal % regular consultations h in mp due to collaboration = 100-goal % regular consultations h in h due to collaboration
A	goal % regular consultations h in mp due to trust = 100-goal % regular consultations h in h due to trust
A	goal % regular consultations mp in h = MAX(goal % regular consultations mp in h due to trust,degree to which collaboration is voluntary*goal % regular consultations mp in h due to trust+(1-degree to which collaboration is voluntary)*goal % regular consultations mp in h due to collaboration)

A	goal % regular consultations mp in h due to collaboration = 100-goal % regular consultations mp in mp due to collaboration
A	goal % regular consultations mp in h due to trust = 100-goal % regular consultations mp in mp due to trust
A	goal % regular consultations mp in mp due to collaboration = TfE collaboration on % consultations in mp by mp(collaboration)
A	goal % regular consultations mp in mp due to trust = TfE trust on % consultations in mp by mp(min trust)
C	goal after collaboration project = 0.8
A	goal capacity h = ratio perceived work pressure h for capacity purposes*capacity h+IF THEN ELSE (S3: (partial) integrated care model 2=1 :AND: Time=11,% midwifery practices that integrates with hospitals*capacity mp,0)
A	goal capacity mp = IF THEN ELSE (S3: (partial) integrated care model 2=1 :AND: (Time=11),(1-% midwifery practices that integrates with hospitals)*capacity mp, (ratio perceived work pressure mp for capacity purposes*capacity mp))
C	goal collaboration S2 & S4 = 0.8
A	goal degree to which collaboration is voluntary = IF THEN ELSE (S2: collaborative model 2=1,goal after collaboration project,iv degree to which collaboration is voluntary)
A	goal max quality of care h = IF THEN ELSE (S on max quality of care h=1,goal max quality of care h S1 & S3 & S4,TfE consultations in h by mp on quality of care h(% regular consultations h in h))
C	goal max quality of care h S1 & S3 & S4 = 1
A	goal max quality of care mp = TfE consultations in mp by h on quality of care mp(% regular consultations mp in mp)
A	goal perceived work pressure h = IF THEN ELSE (capacity h=0,0,total consultations in h/capacity h)
A	goal perceived work pressure mp = IF THEN ELSE (capacity mp=0,0,total consultations in mp/capacity mp)
A	goal quality of care h = weight of preceived effect work pressure on quality of care mp*goal quality of care h due to work pressure+(1-weight of preceived effect work pressure on quality of care mp)*goal quality of care h due to actual collaboration
A	goal quality of care h due to actual collaboration = MAX(goal quality of care h due to trust,degree to which collaboration is voluntary*goal quality of care h due to trust+(1-degree to which collaboration is

	voluntary)*goal quality of care h due to collaboration only)
A	goal quality of care h due to collaboration only = IF THEN ELSE (S3: (partial) integrated care model 2=1 :AND: Time>10,effect S3 collaboration on quality of care*% midwifery practices that integrates with hospitals*MAX quality of care h+(1-% midwifery practices that integrates with hospitals)*E collaboration on quality of care h*MAX quality of care h,E collaboration on quality of care h*MAX quality of care h)
A	goal quality of care h due to trust = IF THEN ELSE (S3: (partial) integrated care model 2=1 :AND: Time>10,effect S3 trust on quality of care h*MAX quality of care h*% midwifery practices that integrates with hospitals+(1-% midwifery practices that integrates with hospitals)*E trust on quality of care h*MAX quality of care h,E trust on quality of care h*MAX quality of care h)
A	goal quality of care h due to work pressure = E work pressure on quality of care h*MAX quality of care h
A	goal quality of care mp = weight of preceived effect work pressure on quality of care mp*goal quality of care mp due to work pressure+(1-weight of preceived effect work pressure on quality of care mp)*goal quality of care mp due to actual collaboration
A	goal quality of care mp due to actual collaboration = MAX(goal quality of care mp due to trust,degree to which collaboration is voluntary*goal quality of care mp due to trust+(1-degree to which collaboration is voluntary)*goal quality of care mp due to collaboration only)
A	goal quality of care mp due to collaboration only = E collaboration on quality of care mp*MAX quality of care mp
A	goal quality of care mp due to trust = E trust on quality of care mp*MAX quality of care mp
A	goal quality of care mp due to work pressure = E work pressure on quality of care mp*MAX quality of care mp
A	goal referral from h to mp = (MAX(goal referral from h to mp according to trust,degree to which collaboration is voluntary*goal referral from h to mp according to trust+(1-degree to which collaboration is voluntary)*goal referral from h to mp according to collaboration))*correction % referrals pw from h to mp due to scenario 1
A	goal referral from h to mp according to collaboration = TfE collaboration on referral from h to mp (collaboration)*MAX flow h to mp
A	goal referral from h to mp according to trust = (TfE* trust h in mp on referral from h to mp(trust h in mp))*MAX flow h to mp
A	goal referral from mp to h = MAX(goal referral from mp to h according to trust,degree to which collaboration is voluntary*goal referral from mp to h according to trust+(1-degree to which collaboration is voluntary)*goal referral from mp to h according to collaboration)

A	goal referral from mp to h according to collaboration = TfE collaboration on referral from mp to h (collaboration)*MAX flow mp to h
A	goal referral from mp to h according to trust = TfE* trust mp in h on referral mp to h(trust mp in h)*MAX flow mp to h
A	goal trust A in B = TfE* lr in h on trust mp in h(ratio low-risk in h)*MAX trust
A	goal trust h in mp = TfE* hr in mp on trust h in mp(ratio high-risk in mp)*MAX trust
F,A	in = IF THEN ELSE (S3: (partial) integrated care model 2=1,% hr presenting in mp*% midwifery practices that integrates with hospitals,0)/TIME STEP
F,A	in 10 = IF THEN ELSE (Time>10,(1-effect S3 collaboration on quality of care)/4,0)
F,A	in 2 = IF THEN ELSE (S3: (partial) integrated care model 2=1,% lr presenting in mp on t tien*% midwifery practices that integrates with hospitals,0)/TIME STEP
F,A	in 9 = IF THEN ELSE (Time>10,(1-effect S3 trust on quality of care h)/4,0)
F,A	in pw = new pw per week
F,A	in pw hr h = in pw hr h 1
A	in pw hr h 1 = (% pw presenting with hr/100)*% hr presenting in h 2*in pw*correction for (partly) integrated care 1
F,A	in pw hr mp = in pw hr mp 1
A	in pw hr mp 1 = (% pw presenting with hr/100)*(1-% hr presenting in h 2)*in pw*correction for (partly) integrated care 1
F,A	in pw lr h = in pw lr h 1
A	in pw lr h 1 = ((100-% pw presenting with hr)/100)*(1-% lr presenting in mp 2)*in

	pw*correction for (partly) integrated care 1
F,A	in pw lr mp = in pw lr mp 1
A	in pw lr mp 1 = ((100-% pw presenting with hr)/100)*% lr presenting in mp 2*in pw*correction for (partly) integrated care 1
C	initial acceptable % lr in h = 5
C	initial acceptable & hr in mp = 10
C	initial AT capacity h = 52 Description: *interview*
C	initial AT capacity mp = 26 Description: *interview*
C	iv % hr presenting in h = 0.62 Description: *48% of the pregnant women who present themselves at the hospital have a high-risk pregnancy at the start(See Chapter 5)13% of the pregnant women who present themselves at the hospital have a pregnancy in which care can be shared between midwife and obstetrician(See Chapter 5)*
C	iv % lr presenting in mp = 0.7 Description: *77.3% of the pregnant women present themselves in primary care(Stichting Perinatale Registratie Nederland, 2009. See also Chapter 4)Of the 22.7% of the pregnant women who present themselves in secondary care(Stichting Perinatale Registratie Nederland, 2009. See also Chapter 4), 39% has a low-risk pregnancy(See Chapter 5)An unknown percentage of the pregnant women who present themselves in primary care has a high-risk pregnancy*
LI,C	iv % pw lr to hr h = 60
LI,C	iv % pw lr to hr mp = 77 Description: *77% of the pregnant women in the midwifery practice develop a complication during pregnancy(See Chapter 5)*
LI,C	iv % referral pw from h to mp = 5 Description: *25 women are referred from the hospital to the midwifery practice, out of the (39+13)% of the 447 women that presented themselves to the hospital(2). However, later on in the care process, no pregnant women are referred to the midwifery practice. Thus the average percentage is lower.*

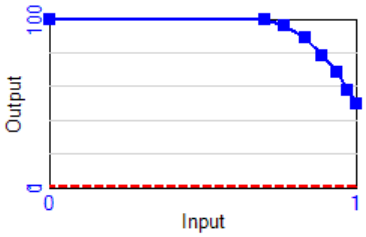
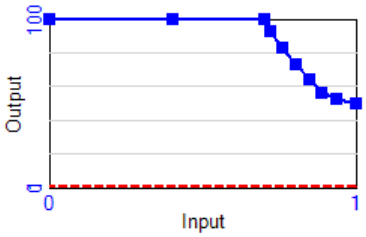
LI,C	iv % referral pw from mp to h = 15
LI,I	iv % regular consultations h in mp = INITIAL(goal % regular consultations h in mp)
LI,I	iv % regular consultations mp in h = INITIAL(goal % regular consultations mp in h)
LI,I	iv capacity h calculated = INITIAL(total consultations in h/reference perceived work pressure h)
LI,I	iv capacity MP calculated = INITIAL(total consultations in mp/reference perceived work pressure mp)
LI,C	iv change % hr presenting in h = 0
LI,C	iv change % lr presenting in mp = 0
LI,C	iv collaboration = 0.4 Description: *Chapter 6*
LI,C	iv degree to which collaboration is voluntary = 0.8 Description: *In some cases collaboration is prescribed, but collaboration between midwives and obstetricians is merely voluntary.*
LI,I	iv delivered quality of care mp = INITIAL(goal quality of care mp)
LI,I	iv max quality of care h = INITIAL(goal max quality of care h) Description: *Obstetricians lack care competences, therefore they will not be able to deliver a quality of care of 1 (quality of care is defined on a scale from 0 to 1)(Indirect modeled in the graph)*
LI,I	iv max quality of care mp = INITIAL(goal max quality of care mp) Description: *Midwives lack cure competences, therefore they will not be able to deliver a quality of care of 1 (quality of care is defined on a scale from 0 to 1) (Indirect modeled in the graph)*
LI,I	iv perceived work pressure mp = INITIAL(goal perceived work pressure mp)
LI,C	iv pw hr h = 139.83 Description: *calculated by the model for equilibrium*
LI,C	iv pw hr mp = 66.89 Description: *calculated by the model for equilibrium*
LI,C	iv pw lr h = 44.65

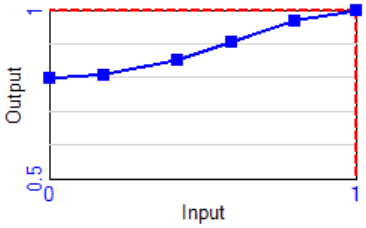
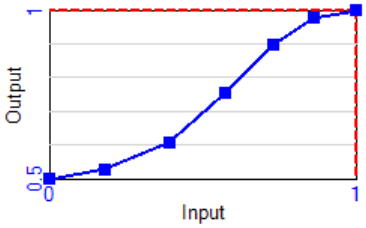
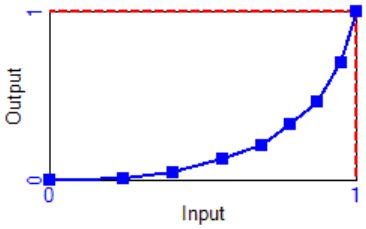
VAB	Description: *calculated by the model for equilibrium*
LI,C VAB	iv pw lr mp = 68.61 Description: *calculated by the model for equilibrium*
LI,I VAB	iv quality of care h = INITIAL(goal quality of care h)
LI,C VAB	iv trust h in mp = 0.25 Description: *Chapter 6*
LI,C VAB	iv trust mp in h = 0.4 Description: *Chapter 6*
LI,I VAB	iv work pressure h = INITIAL(goal perceived work pressure h)
LI,C VAB	length of stay pw = 32 Description: *A pregnancy takes in theory 40 weeks (max 42), the first consultation is around 8-10 weeks. It is assumed that all pregnant women present themselves at this time and that all pregnancies will on average take 40 weeks.*
A VAB	max 2 = MAX(S4: improved hospital model & collaborative model 2,S3: (partial) integrated care model 2)
C VAB	MAX flow h to mp = 100 Description: *It is assumed that when collaboration and trust both are at their max, that referral percentage of low-risk pregnant women from h to mp is 100%*
C VAB	MAX flow mp to h = 100 Description: *It is assumed that when collaboration and trust both are at their max, that referral percentage of high-risk pregnant women from mp to h is 100%*
L VAR	MAX quality of care h = ∫C max quality of care h dt + [iv max quality of care h]
L VAR	MAX quality of care mp = ∫C max quality mp dt + [iv max quality of care mp]
C VAB	MAX trust = 1 Description: *Chosen definition of trust: between 0 and 1*
C VAB	MIN % lr to hr = 40
A VAB	min trust = MIN(trust h in mp,trust mp in h)

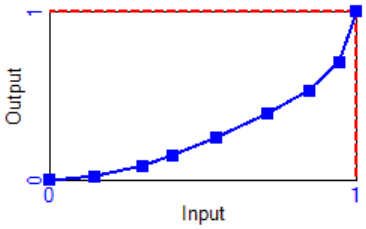
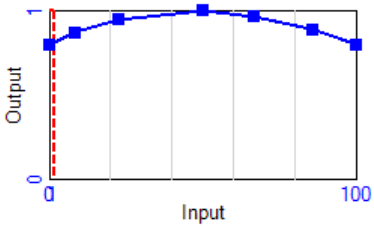
LI,C	new pw per week = 10
F,A	out pw = pregnant women/length of stay pw
F,A	out pw hr h = (pw hr h/length of stay pw)*S5-2
F,A	out pw hr mp = (pw hr mp/length of stay pw)*S5-2
F,A	out pw lr h = (pw lr h/length of stay pw)*S5-2
F,A	out pw lr mp = (pw lr mp/length of stay pw)*S5-2
L	perceived work pressure in h = ∫C perceived work pressure h dt + [iv work pressure h]
L	perceived work pressure in mp = ∫C perceived work pressure mp dt + [iv perceived work pressure mp]
L	pregnant women = ∫in pw-out pw dt + [length of stay pw*new pw per week]
L	pw hr h = ∫from lr h to hr h+in pw hr h+referring hr from mp to h+S5 flow hr-from hr h to lr h-out pw hr h dt + [iv pw hr h]
L	pw hr mp = ∫from lr mp to hr mp+in pw hr mp-from hr mp to lr mp-out pw hr mp-referring hr from mp to h-S5 flow hr dt + [iv pw hr mp]
L	pw lr h = ∫from hr h to lr h+in pw lr h+S5 flow lr-from lr h to hr h-out pw lr h-referring lr from h to mp dt + [iv pw lr h]
L	pw lr mp = ∫from hr mp to lr mp+in pw lr mp+referring lr from h to mp-from lr mp to hr mp-out pw lr mp-S5 flow lr dt + [iv pw lr mp]
A	pw total h = pw lr h+pw hr h
A	pw total mp = pw hr mp+pw lr mp
A	ratio high-risk in mp = IF THEN ELSE (acceptable % hr in mp=0,0,% high-risk in mp of all

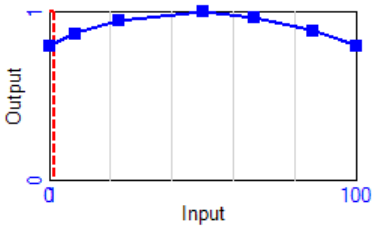
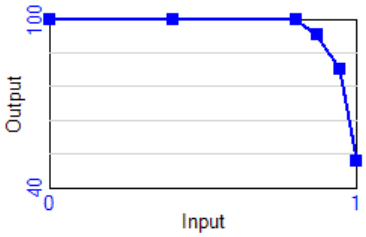
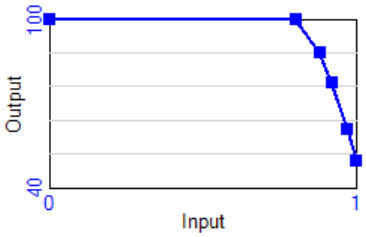
	women/acceptable % hr in mp)
A	ratio low-risk in h = % low-risk in h of all women/acceptable % lr in h
A	ratio perceived work pressure h for capacity purposes = perceived work pressure in h/reference perceived work pressure h
A	ratio perceived work pressure mp for capacity purposes = perceived work pressure in mp/reference perceived work pressure mp
C	reference perceived work pressure h = 1.2 Description: *observation*
C	reference perceived work pressure mp = 1.1 Description: *observation*
F,A	referring hr from mp to h = ((% referral pw from mp to h/100)*pw hr mp/AT refer from mp to h)*correction for (partly) integrated care 2
F,A	referring lr from h to mp = IF THEN ELSE (S3: (partial) integrated care model 2=1 :AND: Time>=11, (1-% midwifery practices that integrates with hospitals)*(% referral pw from h to mp 2/100)*pw lr h/AT refer from h to mp,(% referral pw from h to mp 2/100)*pw lr h/AT refer from h to mp)
A	regular consultations h in h = pw total h*regular consultations in h*% regular consultations h in h/100
A	regular consultations h in mp = pw total h*regular consultations in h*(100-% regular consultations h in h)/100
C	regular consultations in h = 13 Description: *13 consultations are recommended (Heineman et al., 2004. See also Chapter 4)*
C	regular consultations in mp = 12 Description: *12 consultations are conducted at the midwifery practice, both for the low-risk as for the high-risk pregnancies(See Chapter 5)*
A	regular consultations mp in h = pw total mp*regular consultations in mp*(100-% regular consultations mp in mp)/100
A	regular consultations mp in mp = % regular consultations mp in mp*pw total mp*regular consultations in mp/100
A	S on collaboration = MAX(S2: collaborative model,S4: improved hospital model & collaborative model)
A	S on impuls collaboration 2

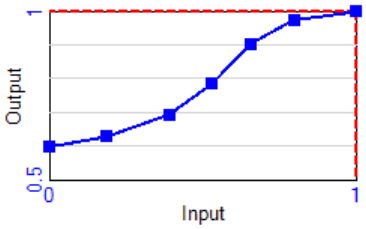
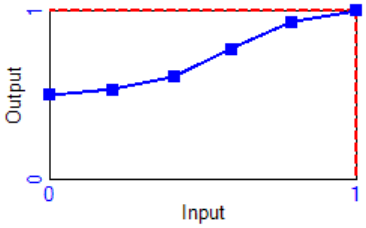
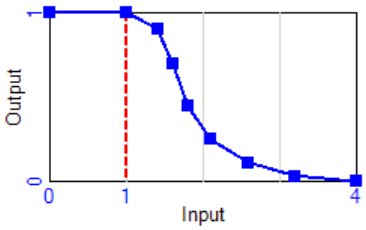
VAR	= IF THEN ELSE (S on collaboration=1,0+1*PULSE(start intervention,duration intervention),0)
A VAR	S on max quality of care h = MAX(max 2,S1: improved hospital model 2)
C VAR	S1: improved hospital model = 0
A VAR	S1: improved hospital model 2 = IF THEN ELSE (S1: improved hospital model=1,0+STEP(1,10),0)
A VAR	S2: collaborative model = IF THEN ELSE (S5: partly integrated care & collaborative model=1,1,0)
A VAR	S2: collaborative model 2 = IF THEN ELSE (S2: collaborative model=1,0+STEP(1,10),0)
A VAR	S3: (partial) integrated care model = IF THEN ELSE (S5: partly integrated care & collaborative model=1,1,0)
A VAR	S3: (partial) integrated care model 2 = IF THEN ELSE (S3: (partial) integrated care model=1,0+STEP(1,10),0)
C VAR	S4: improved hospital model & collaborative model = 0
A VAR	S4: improved hospital model & collaborative model 2 = IF THEN ELSE (S4: improved hospital model & collaborative model=1,0+STEP(1,10),0)
F,A VAR FLOW	S5 flow hr = MAX(0,IF THEN ELSE(S3: (partial) integrated care model 2=0,0,if then else (Time=11,% midwifery practices that integrates with hospitals*pw hr mp,0))-% midwifery practices that integrates with hospitals*referring hr from mp to h)
F,A VAR FLOW	S5 flow lr = IF THEN ELSE (S3: (partial) integrated care model 2=0,0,if then else (Time=11,% midwifery practices that integrates with hospitals*pw lr mp,0))
C VAR	S5: partly integrated care & collaborative model = 1
A VAR	S5: partly integrated care & collaborative model 2 = IF THEN ELSE (S5: partly integrated care & collaborative model=1,0+STEP(1,10),0)
A VAR	S5-2 = IF THEN ELSE (S3: (partial) integrated care model 2=1 :AND: (Time =11),0,1)
C VAR	start intervention = 10
C VAR	temporarily adjustment AT capacity h integrated care = 1
C	temporarily adjustment AT capacity mp integrated care

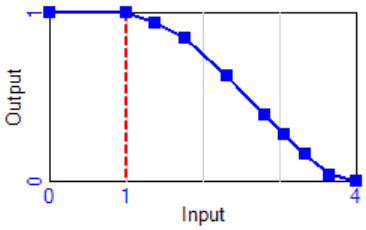
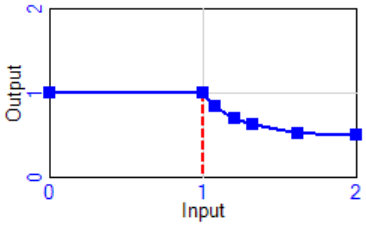
VAB	= 1
L	TfE collaboration on % consultations in h by h = [(0,0)-(1,100)],(0,100),(0.7,100),(0.761468,96.9298),(0.828746,89.4737),(0.88685,79.386),(0.93578,69.2982),(0.969419,58.7719),(1,50) Description: *Decreasing curve through (0,100), (0,7;100) and (1,50). Collaboration has to be at least 0.8 before obstetricians will allow midwives to do preventive consultations. This curve is more conservative than the curve for midwives because obstetricians see less advantage of having care consultations in midwifery practices than midwives see the advantage of having cure consultations in hospitals.*: 
L	TfE collaboration on % consultations in mp by mp = [(0,0)-(1,100)],(0,100),(0.4,100),(0.7,100),(0.718654,93.4211),(0.755352,83.3333),(0.801223,73.6842),(0.847095,64.4737),(0.88685,57.0175),(0.932722,53.0702),(1,50) Description: *Decreasing curve through (0,100), (0,7;100) and (1,50). Collaboration has to be at least 0.7 before midwives will allow obstetricians to do preventive consultations.* 
L	TfE collaboration on quality of care h = [(0,0.5)-(1,1)],(0,0.8),(0.174312,0.811404),(0.412844,0.85307),(0.593272,0.907895),(0.798165,0.971491),(1,1) Description: *Increasing S-curve with the extremes (0,0.8) and (1,1).*

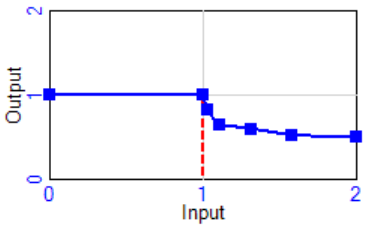
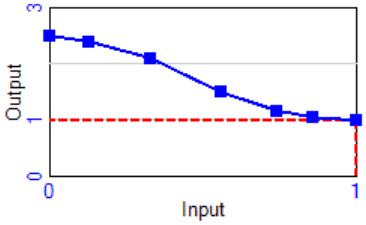
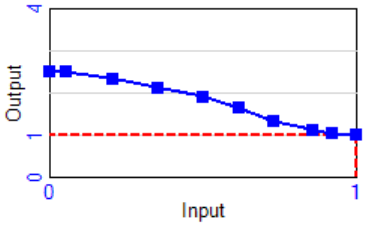
	
L	TfE collaboration on quality of care mp = [(0,0.5)- (1,1)],(0,0.5),(0.17737,0.530702),(0.388379,0.609649),(0.568807,0.754386),(0.727829,0.899123),(0.859327,0.97807),(1,1) Description: *Increasing S-curve with the extremes (0,0.5) and (1,1).* 
L	TfE collaboration on referral from h to mp = [(0,0)- (1,1)],(0,0),(0.238532,0.0131579),(0.4,0.05),(0.559633,0.127193),(0.691131,0.210526),(0.782875,0.333333),(0.87156,0.464912),(0.948012,0.701754),(1,1) Description: *Increasing graph with the extremes (0,0) and (1,1)* 
L	TfE collaboration on referral from mp to h = [(0,0)- (1,1)],(0,0),(0.146789,0.0263158),(0.302752,0.0877193),(0.4,0.15),(0.541284,0.254386),(0.706422,0.394737),(0.844037,0.535088),(0.941896,0.701754),(1,1) Description: *Increasing graph with the extremes (0,0) and (1,1)*

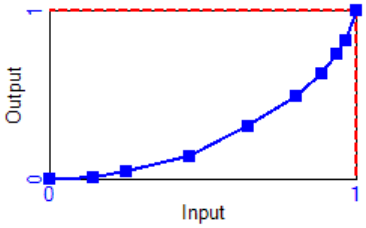
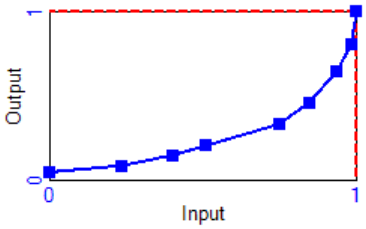
	
L	TfE consultations in h by mp on quality of care h = [(0,0)-(100,1)],(0,0.8),(7.95107,0.872807),(22.3242,0.947368),(50,1),(66.6667,0.964912),(85.6269,0.890351),(100,0.8) Description: *Top-parabolic curve with the extremes (0,0.8) and (100,0.8) and the top (50,1). When all consultations in the h are conducted by the hospital, the max quality of care of the h is suboptimal because obstetricians lack care competences. When all consultations in the h are conducted by the midwifery practice, then the max quality of care is also suboptimal because midwives lack cure competences.* 
L	TfE consultations in mp by h on quality of care mp = [(0,0)-(100,1)],(0,0.8),(7.95107,0.872807),(22.3242,0.947368),(50,1),(66.6667,0.964912),(85.6269,0.890351),(100,0.8) Description: *Top-parabolic curve with the extremes (0,0.8) and (100,0.8) and the top (50,1). When all consultations in the mp are conducted by the midwifery practice, the max quality of care of the mp is suboptimal because midwives lack cure competences. When all consultations in the mp are conducted by the hospital, then the max quality of care is also suboptimal because obstetricians lack care competences.*

	
L	TfE trust on % consultations h in h = [(0,40)-(1,100)],(0,100),(0.4,100),(0.8,100),(0.868502,94.7368),(0.944954,82.4561),(1,50) Description: *Decreasing curve through (0,100), (0,8;100) and (1,50). Trust has to be at least 0.8 before midwives will allow obstetricians to do preventive consultations. This curve is more conservative than the curve for midwives because obstetricians see less advantage of having care consultations in midwifery practices than midwives see the advantage of having cure consultations in hospitals.* 
L	TfE trust on % consultations in mp by mp = [(0,40)-(1,100)],(0,100),(0.8,100),(0.877676,88.4211),(0.917431,77.6316),(0.969419,61.0526),(1,50) Description: *Decreasing curve through (0,100), (0,8;100) and (1,50). Trust has to be at least 0.7 before midwives will allow obstetricians to do preventive consultations.* 

L	TfE trust on quality of care h = [(0,0.5)-(1,1)],(0,0.6),(0.183486,0.629386),(0.388379,0.695175),(0.529052,0.787281),(0.654434,0.905702),(0.795107,0.975877),(1,1) Description: *Increasing S-curve with the extremes (0,0.6) and (1,1).* 
L	TfE trust on quality of care mp = [(0,0)-(1,1)],(0,0.5),(0.201835,0.535088),(0.40367,0.609649),(0.590214,0.776316),(0.785933,0.934211),(1,1) Description: *Increasing S-curve with the extremes (0,0.5) and (1,1).* 
L	TfE* hr in mp on trust h in mp = [(0,0)-(4,1)],(0,1),(1,1),(1.3945,0.907895),(1.60245,0.697368),(1.79817,0.447368),(2.09,0.25),(2.091,0.25),(2.58104,0.114035),(3.18043,0.0350877),(4,0) Description: *Decreasing S-curve with beginning (0,1) and ending (4,0). Special point is (1,1): As long as the ratio of high-risk pregnancies in the midwifery practice is less than 1, the number of high-risk pregnancies in the midwifery practice is acceptable for obstetricians.* 
L	TfE* lr in h on trust mp in h

	= [(0,0)-(4,1)],(0,1),(1,1),(1.3578,0.942982),(1.74924,0.855263),(2.29969,0.627193),(2.79,0.4),(2.791,0.4),(3.04587,0.285088),(3.31498,0.162281),(3.64526,0.0438596),(4,0) Description: *Decreasing S-curve with beginning (0,1) and ending (4,0). Special point is (1,1): As long as the ratio of low-risk pregnancies in the hospital is less than 1, the number of low-risk pregnancies in the hospital is acceptable for midwives.* 
L	TfE* perceived work pressure h on quality of care h = [(0,0)-(2,2)],(0,1),(1,1),(1.07034,0.842105),(1.2,0.7),(1.201,0.7),(1.31498,0.631579),(1.60856,0.526316),(2,0.5) Description: *The graph is a straight line from (0,1) to (1,1), and till (2, 0.5) it is a decreasing function* 
L	TfE* perceived work pressure mp on quality of care mp = [(0,0)-(2,2)],(0,1),(1,1),(1.02141,0.824561),(1.1,0.65),(1.101,0.65),(1.30887,0.605263),(1.57187,0.526316),(2,0.5) Description: *The graph is a straight line from (0,1) to (1,1), and till (2, 0.5) it is a decreasing function*

	
L	TfE* quality of care h on % pw lr to hr h = [(0,0)-(1,3)],(0,2.5),(0.125382,2.40351),(0.327217,2.10526),(0.5577,1.5),(0.5578,1.5),(0.737003,1.17544),(0.856269,1.05263),(1,1) Description: *Decreasing S-curve through (0,2.5) and (1,1)* 
L	TfE* quality of care mp on % pw lr to hr mp = [(0,0)-(1,4)],(0,2.5),(0.0519878,2.5),(0.201835,2.35088),(0.348624,2.14035),(0.4998,1.925),(0.4999,1.925),(0.614679,1.64912),(0.727829,1.33333),(0.853211,1.14035),(0.917431,1.03509),(1,1) Description: *Decreasing S-curve through (0,2.5) and (1,1)* 
L	TfE* trust h in mp on referral from h to mp = [(0,0)-(1,1)],(0,0),(0.140673,0.0131579),(0.25,0.05),(0.2501,0.05),(0.455657,0.140351),(0.64526,0.320175),(0.801223,0.491228),(0.883792,0.627193),(0.93578,0.745614),(0.963303,0.824561),(1,1) Description: *Increasing graph with the extremes (0,0) and (1,1)*

	
L	TfE* trust mp in h on referral mp to h = [(0,0)- (1,1)],(0,0.05),(0.232416,0.0877193),(0.4,0.15),(0.401,0.15),(0.507645,0.20614),(0.746177,0.333333),(0.844037,0.460526),(0.93578,0.649123),(0.981651,0.807018),(1,1) Description: *Increasing graph with the extremes (0,0) and (1,1)* 
C	time developing hr in h = 10
C	time developing hr in mp = 10
C	time recovering hr in h = 8
C	time recovering hr in mp = 8
C	TIME STEP (Week [0,?]) = 1 Description: *The time step for the simulation.*
A	total consultations in h = (regular consultations h in h+regular consultations mp in h+extra consultations h in h+extra consultations mp in h)/length of stay pw
A	total consultations in mp = (regular consultations mp in mp+regular consultations h in mp+extra consultations mp in mp+extra consultations h in mp)/length of stay pw
A	total women = pw hr h+pw hr mp+pw lr h+pw lr mp

L	trust h in mp = ∫C trust h in mp dt + [iv trust h in mp]
L	trust mp in h = ∫C trust mp in h dt + [iv trust mp in h]
C	weight of preceived effect work pressure on quality of care mp = 0.7
C	willingness to send lr pw from h to mp = 0 Description: *0 = no women sending back, 1 act as system tells you to based on trust*

Summary

Summary

Chapter 1. Introduction

The first chapter presents the background to the topic of this research. Improving the performance of the healthcare sector is a task of major societal importance, and there appears to be a broad consensus that the *design* of the services provided in healthcare is in urgent need of improvement. Traditionally, healthcare services were organized functionally, per discipline and geographically, with each specialism having its own department or organization. This is not working well: it has resulted in fragmented and poorly coordinated care and in low service quality. One response is to design healthcare services more from the perspective of the patient (patient-focused care). In addition, traditionally, healthcare is delivered according to the "acute care" model. It is specialist care, focused on medical intervention, delivered in hospitals. Nowadays, it is more and more recognized that healthcare can be improved by refocus toward proactive maintenance. Care must reach beyond the traditional healthcare organizations into patients' lives in the community, and patients should be given increased responsibility for the day-to-day management of their disease.

There is a prominent and increasing role in healthcare for chronic conditions as cardiovascular risk, diabetes mellitus, chronic obstructive pulmonary disease, and congestive heart failure. These chronic conditions have in common that they require different levels of care. Most of the time, patients can monitor their condition themselves, although they regularly require general, preventive monitoring, education, psycho-sociological help, etcetera, which is called the need for *care* in this research. In case of an episode, patients need specialized, medical intervention, what we refer to as a need for *cure*. *Care* and *cure* can be delivered by the same professional, although, in the highly specialized practice of healthcare, they are mostly delivered by different professionals. An example: for diabetes, a specialized diabetes nurse is an example of a *care* professional, whereas the vascular surgeon is an example of a *cure* professional. Not only do most chronic conditions fit this category, also some mental health disorders (such as depression) and pregnancy fit in.

This research focuses on the inter-organizational level of the healthcare system, since the main goal of a healthcare system is to improve the health of a population. As such, it is not the performance of individual organizations that counts, but the performance of the system as a whole. For *care-cure* conditions, the literature shows that there are different inter-organizational designs in place, none of them being superior to the others. Each of these designs has its flaws and the literature remains ambiguous regarding what design would

work best. The research objective of this study therefore is: *What inter-organizational design would work best for care-cure conditions, so that patients' needs are met, and that problems due to fragmentation are overcome?* This research objective will be studied from an operations strategy/operations management perspective, applying a mixed methods approach.

Chapter 2. Inter-Organizational Designs for *Care-Cure* Conditions, a Literature Review

The second chapter digs into the literature regarding the research objective. It starts with an exploration of what *care* and *cure* are. These concepts are used in a variety of ways in the literature and in practice: they can refer to activities, attitudes, organizations, and sectors. In this research, they refer to the needs of the patients, as discussed above. The main part of the chapter focuses on the status quo regarding inter-organizational designs for *care-cure* conditions. It discusses four topics. The first topic regards the inter-organizational designs that can currently be found for *care-cure* conditions (Section 2.3). Traditionally, healthcare was delivered according to the "acute care" model, focusing on meeting the *cure* needs of patients. Nowadays, different inter-organizational designs can be found, varying from organizations that are able to meet both the *care* and the *cure* needs, to organizations that are specialized in meeting only a specific need of a specific type of patients.

The second topic focuses on the problems current inter-organizational designs for *care-cure* conditions have (Section 2.4). In short, five different problems can be discerned. Firstly, there are problems due to fragmentation and coordination when *care* and *cure* are delivered by different organizations. Secondly, there are problems regarding the knowledge of professionals. Thirdly, there are doubts on the performance, in terms of medical performance and costs, of organizations that deliver both *care* and *cure*, i.e. specialty hospitals. Fourthly, there are problems of professionals not understanding the system as a whole and the roles and responsibilities of other organizations and professionals. Finally, there are problems of competition that might stand in the way of delivering high quality of care.

The third topic focuses on the solutions that are found to cope with these problems (Section 2.5). Solutions are found in integrating the delivery of *care* and *cure*, in moving towards integrated care. Integrated care can be described as a coherent and coordinated set of services which are planned, managed and delivered to individual service users across a range of organizations and by a range of co-operating professionals and informal carers. Examples are Disease Management, Chronic Illness Care Model, integrated care,

transmural care, shared care, care pathways, integrated delivery networks, and inter-organizational networks.

Fourthly, a closer look at the solutions as described above, teaches us that what they have in common is that they all focus on improving inter-organizational collaboration (Section 2.6). Collaboration can be studied on different levels: micro- macro, personal-group-role-institutional, and vertical-horizontal-lateral. This research focuses on horizontal collaboration on a personal/role and macro level. It concerns collaboration in the healthcare sector between professionals from different organizations. Although a variety of definitions refer to different types of collaboration (coordination, cooperation, collaboration, relational coordination and even coopetition), this research marks collaboration by knowledge contribution, equal distribution of power, and a focus on achieving best outcomes without regard to discipline, hierarchy, or even organizational boundaries. Collaboration does not happen overnight, drivers and barriers can be discerned at three levels. Firstly, on the individual level: the differences between professionals, trust, power, status, work pressure, collaboration skills, and regular personal contact. Secondly, on the organizational level: cultural differences between organizations and coordination mechanisms such as cross-functional meetings, shared incentives, shared goals, shared supervision, and shared information systems. In addition, team structure and team processes are important, such as team size, team composition, leadership, mutual respect, a shared code of ethics. Finally, on the national level, a proactive policy by government and an integrated payment system can stimulate collaboration across organizations.

Chapter 3. Research Design and Methods

Since the literature is ambiguous regarding what the best inter-organizational design for *care-cure* conditions would be, more intensive research is needed, specifically on the dynamics of collaboration between organizations and the relation with the outcomes and the inter-organizational design. Chapter 3 presents an extensive description of the research design and the methods applied. Overall, a mixed methods approach is applied (Section 3.2), where qualitative and quantitative methods are combined. This research aims to contribute to the development of theory regarding inter-organizational designs in the healthcare sector through a combination of case study research and simulation (Section 3.3). The case setting chosen is perinatal care in the Netherlands (Section 3.4).

The case study consists of three phases. The first phase focuses on what is wrong in Dutch perinatal care and on why it does not work well (what-question). The methods used are described in Section 3.5. First, an analysis is made, based on available literature, on the organization of Dutch perinatal care, its performance, and the reasons for malfunctioning.

Secondly, in-depth research is conducted regarding one of the reasons for malfunctioning: the current structure of the system. From an operations management/strategy perspective, in order to achieve great performance, there should be a high internal and external fit. Internal fit refers to what degree the Dutch perinatal care system will be internally consistent; external fit refers to what extent internal processes will be aligned with the characteristics of the medical condition, i.e., pregnancy, and the institutional environment. Thus to assess the applicability of the current design in Dutch perinatal care is to assess the degree of internal and external fit. Archival data analysis on patient flows is used to gain insight into both.

The second phase focuses on why it is going wrong, on understanding what causes the problem (why-question). The focus lies on inter-organizational dynamics, since this is one of the key factors according to the literature review, and since pregnant women flow or should flow from midwifery practices to hospitals and vice versa, based on their changing risk levels. The approach taken is described in Section 3.6 and focuses on helping a selected region improve its perinatal care. Research in this phase is conducted from a clinical perspective. In clinical research, researchers are hired to help, the research agenda comes from the needs of the client, and data gathering is driven by the client's needs. The site selected is the city of Tilburg and its surrounding villages, which consists of two hospitals and twelve midwifery practices. With the help of the Renga method, the mental models of obstetricians and midwives regarding the perinatal care system en regarding the dynamics of inter-organizational collaboration are investigated. The Renga method consists of questionnaires, interviews, group model building workshops, and plenary sessions. In addition, improvement proposals are defined, and task forces are put in place to implement them.

The third phase focuses on gaining insight into how Dutch perinatal care can be improved, on what inter-organizational design would work best for Dutch perinatal care (how-question). Different inter-organizational designs can be found in practice and are evaluated with the help of a system dynamics model, which resides in the findings from the previous phases and the literature. This method is discussed in Section 3.7.

Construct, internal and external validity, and generalizability are discussed in Section 3.8.

Chapter 4. Perinatal Care in the Netherlands

Perinatal care in this research is defined as the care for pregnant women, starting from the moment they get pregnant up to and including the delivery. Chapter 4 focuses on the first phase of this research, on what goes wrong. It describes the Dutch perinatal care system and

its performance in detail. This study shows that the current design is based on principles of the focused factory concept (Section 4.3). The population of pregnant women is split in low-risk and high-risk pregnant women, with low-risk pregnant women being cared for by midwifery practices, and high-risk pregnant women being cared for by obstetric departments in hospitals. Although Dutch perinatal care performs well regarding the number of obstetric interventions, the number of home births, and overall costs, it does not perform well regarding perinatal and maternal morbidity and mortality. In addition, the satisfaction of pregnant women with the care they receive is not as high as one would strive for (Section 4.4). Reasons for this malfunctioning can be found in the characteristics of pregnant women, such as age, smoking, ethnic background, in the efficiency of the current system, such as the availability of professionals 24/7, and the competences of professionals, and in the structure of the system: should one have a clear distinction between midwifery practices and hospitals, or should one need to move more towards integrated care (Section 4.5)? The recommendations made by the Department of Health to improve Dutch perinatal care all focus especially on the care process, and not so much on the underlying structure (Section 4.6). Even when the recommendations are put in place, there will still be a system where pregnant women flow from one organization (midwifery practices) to the other (hospitals) and vice versa. And as a result, the accompanied problems might still exist.

Chapter 5. Limits to the Design of Dutch Perinatal Care

Chapter 5 focuses on the first phase of this research in more detail; it focuses on the structure of the system. It investigates if the design concept of Dutch perinatal care is working well, and if not, why this is. Whether or not the design of Dutch perinatal care is working well is answered by focusing on internal fit: the inter-organizational *design* of the system is compared with the inter-organizational *practice*. Four expectations regarding how Dutch perinatal care should operate based on its design are formulated. Archival analysis regarding patient flows is conducted. Patient data from pregnant women from a particular year from one hospital and one midwifery practice are collected: data on individual consultations during pregnancy, and detailed data regarding delivery. Why the current design is not working well is answered by focusing on the external fit (Section 5.2).

This research shows that the current design of Dutch perinatal care does not work well (Section 5.3). There is no good fit between the design of the system and the way it actually operates. First of all, there is a fair amount of transfer of pregnant women between the two organizations: 77% of the pregnant women who start in the midwifery practice are also taken care of in the hospital. Secondly, there is a fair amount of low-risk pregnant women being taken care of in the hospital: 50% of the pregnant women in the hospital were

categorized as being low-risk, while still pursuing their care process in the hospital, which should be the organization which only takes care of high-risk pregnant women. Thirdly, the midwifery practice only takes care of a very small number of pregnant women: 23% of the pregnant women that start in the midwifery practice only receive care from this midwifery practice, the other 77% also need more specialized care (*cure*). Finally, in the obstetric department in the hospital, the obstetricians conduct only 34% of the consultations; the rest is conducted by lower skilled staff as residents, midwives and nurses. If most of the work in the hospital can be done by lower skilled staff, why would it be efficient to have a system of focused factories where two different types of organizations offer lower skilled consultations?

Root causes for the misalignment between how Dutch perinatal care is organized and how it actually operates are found in the characteristics of the condition of being pregnancy (the ex-ante predictability of which patient will turn out to fall in the category low-risk or high-risk is low, and pregnancy and delivery always require both *care* and *cure)*, in the behavior of the pregnant women (preferences and behavior of pregnant women are aligned towards high-level care, towards *cure*), and in the behavior of the midwives and obstetricians (the institutional split between midwifery practices and hospitals creates organizational inertia and stickiness) (Section 5.4).

Chapter 6. Inter-Organizational Collaboration in Dutch Perinatal Care

This chapter focuses on the second phase of this research. In searching for why it is going wrong, this research digs deeper into the organizational inertia by focusing on the behavior of midwives and obstetricians, on the collaboration between them, and on the effect on the care process. An in-depth case study has been conducted in the selected site (Tilburg and its surrounding villages), as is described in Section 6.2.

The current status of the collaboration between midwives and obstetricians is described in Section 6.3, and in general, they believe there is value in collaborating together. Firstly, all parties agree that it is expected to keep the other informed about events or changes that may affect the other. However, in practice, it seems that midwives provide obstetricians with more information than the other way around. Secondly, in general, midwives and obstetricians trust each other, although midwives have more confidence in the relation than obstetricians have. Thirdly, midwives and obstetricians believe that the prerequisites for improving performance are in place; the relationship is flexible in response to requests for a change, the relationship helps them functioning better. However, when it comes to real performance (i.e. increased service to patients, increased quality of work, and lower costs), midwives are more positive about it then obstetricians. Fourthly, although all parties expect

the relationship to last a long time, and that it resembles a strong marriage, the relationship cannot be called symmetric. Midwives feel stronger than obstetricians that it is a shared responsibility to make sure that the relationships works and to treat problems. In addition, midwives feel they depend strongly on obstetricians, whereas obstetricians do not feel they depend on midwives.

The inter-organizational dynamics are described in Section 6.4. The interviews, the causal loop diagrams, the discussions in the plenary session, the researcher's experiences as a project manager, they all stress that the root causes of why things go wrong in perinatal care are a lack of trust, feelings of competition, a sub-optimal exchange of information and sub-optimal communication between midwifery practices and obstetric departments in hospitals. Trust and knowing each other are prerequisites for collaboration. In addition, not only have the dynamics between organizations (between midwifery practices, between hospitals, and between midwifery practices and hospitals) an effect on overall collaboration in the region, also the dynamics within an organization (especially within hospitals) have an effect.

Preliminary guidelines on how to improve perinatal care are presented in Section 6.5. The professionals expect that collaboration in the region (exchange of information, streamlined care processes, and knowing each other better, both professionally as well as personally) results in higher quality of care, in higher patient satisfaction and in higher professional satisfaction. The improvements the professionals defined all contribute to these three topics; they are all expected to result in higher collaboration, and in making the perinatal care system a more integrated one.

Chapter 7. Evaluating Inter-Organizational Designs in Dutch Perinatal Care

The third phase of this research focuses on how Dutch perinatal care can be improved, on what inter-organizational design would work best. System dynamics is used as the method of modeling. The system dynamics model is grounded in the case study and literature and as such it is based on different sources of data: mental, written and numerical data (Section 7.2).

The system dynamics model evaluates six different inter-organizational models in Dutch perinatal care: four generic models and two combined models. The first generic model is the base case, which is the current model where low-risk pregnant women are being taken care of in midwifery practices and where high-risk pregnant women are being taken care of in hospitals. The second model is a collaborative model, in which the current model is enhanced by improved collaboration between midwifery practices and hospitals. In the

third model, the improved hospital model, hospitals add midwives to their staff. As such, it is expected that not only the *cure* needs will be met for pregnant women in the hospitals, but also the *care* needs. In the fourth generic model, the integrated care model, some midwifery practices will integrate with a hospital, whereas the other midwifery practices will remain independent. The first combined model is the improved hospital + model, which builds on two generic models: not only are midwives added to the hospitals, also is the collaboration between hospitals and midwifery practices improved. In the final design, the integrated care + model, not only do some midwifery practices integrate with a hospital, but also is the collaboration between the hospitals and the remaining independent midwifery practices improved.

The model consists of several variables and relations between them (Section 7.4). Some variables in the model relate to the pregnant women and where they are being taken care of (low-risk pregnant women in midwifery practices, high-risk pregnant women in midwifery practices, low-risk pregnant women in hospitals and high-risk pregnant women in hospitals). Other variables relate to the inter-organizational dynamics: trust midwifery practices have in hospitals, trust hospitals have in midwifery practices, and the level of collaboration between midwifery practices and hospitals. Variables as quality of care and work pressure, both from midwifery practices as well as from hospitals, are incorporated in the model too. In addition, four performance indicators are defined: medical performance, effectiveness, satisfaction of pregnant women, and satisfaction of staff (Section 7.5).

There are several implications for Dutch perinatal care (Section 7.6). Firstly, for Dutch perinatal care the best thing to do is to implement the collaborative model, i.e. to improve collaboration between all independent midwifery practices and obstetric departments in hospitals, because of the virtuous cycles of trust and transparency that are nurtured in this setting. A second finding is that the improved hospital model performs the worst. This research carries a warning for hospitals that choose, consciously or not, for an improved hospital model. If they do so, they might be able to deliver a higher quality of care and to increase their own performance, but the percentage of high-risk pregnant women that is being taken care of in the wrong organization (in the midwifery practices) will increase. As such, total performance of the system will decrease. The improved hospital model can increase performance of the system, but only when it is combined with increased collaboration with midwifery practices. Thirdly, when some midwifery practices decide to integrate with the hospitals, whereas the bulk of the midwifery practices remain independent and outside of the collaboration, the performance in the system will get worse. Increasing the percentage of midwifery practices that integrates with the hospital makes performance better, as well as improving collaboration between the integrated organization and the independent midwifery practices.

Chapter 8. Discussion and Conclusion

This study has conclusions on three different levels: for Dutch perinatal care, for other perinatal care systems, and for *care-cure* conditions.

Dutch Perinatal Care

For Dutch perinatal care, the conclusions are presented above in the chapters four through seven. A brief summary: Firstly, for Dutch perinatal care, this study has shown (Chapter 4) that Dutch perinatal care has problems regarding perinatal and maternal morbidity and mortality rates, and satisfaction of pregnant women is not as high as one would strive for. Reasons for this malfunctioning can be found in the characteristics of the condition and the pregnant women, in the efficiency of the current system, and in the structure, the inter-organizational design, of the current system. This research focuses on the latter reason: the structure of the system. The study also shows that the current design is based on principles of the focused factory concept: midwifery practices are responsible for low-risk pregnant women, obstetric departments in hospitals for high-risk pregnant women. Chapter 5 digs deeper in this structure; it shows that the perinatal care system does not achieve a good fit between how it is designed and how it actually operates in practice. This is due to the characteristics of the condition, to the behavior and preferences of pregnant women, and to the behavior of the professionals and the structure of the system. This research focuses on the latter: a lack of trust, feelings of competition, a sub-optimal exchange of information and sub-optimal communication between midwifery practices and hospitals stand in the way of successful collaboration (Chapter 6). And this collaboration is important since pregnant women flow or should flow between the two types of organizations. The solution that this research focuses on is to look for a different inter-organizational design (Chapter 7). For Dutch perinatal care, the best thing to do is to implement the collaborative model, i.e. to improve collaboration between all independent midwifery practices and obstetric departments in hospitals. The model where hospitals improve their quality of care by adding professionals with *care* competencies to their *cure* competencies driven organization, results in sub-optimization. In addition, the competition-driven model, where some *care* providers are closely integrate with *cure* providers is found to lead to inferior results also. The improved hospital model and the integrated care model might only work if at the same time the collaboration with the midwifery practices is increased (improved hospital + model and the integrated care + model).

Perinatal Care Systems

What these findings mean in practice for other countries depends on the existing system that is in place. For perinatal care systems which are built on the medical model and which are thinking about moving towards a more midwifery model, this research carries the advice to be careful with introducing independent midwifery practices. Choosing an inter-

organizational design in which there is a clear split between midwifery practices that focus on low-risk pregnant women and obstetric departments in hospitals that focus on high-risk pregnant women will not work, since it is not known in advance whether a pregnancy will turn out to be a low- or a high-risk one, and since pregnant women need both *care* and *cure*. Having independent midwifery practices only works well when there are high levels of collaboration and trust with the *cure* providers, i.e. obstetric departments in hospitals. Otherwise, feelings of competition will dominate and pregnant women will receive less optimal care. Instead of introducing independent midwifery practices that focus on low-risk pregnant women, it might be better to have midwives working side by side with obstetricians in the same organization, in one team.

For perinatal care systems that are based on the midwifery model and that consist both of obstetric departments in hospitals and of midwifery practices, this research carries the following advice. When improving perinatal care, one has to be careful with improving the care process in one organization only, since this might result in sub-optimization, especially when the system expects pregnant women to be referred between organizations when their risk level changes. Improving the care process in the hospitals might result in better performance *in* the hospitals, but because of vicious cycles of eroding trust between hospitals and midwifery practices, performance of the system *as a whole* might decrease.

Care-Cure Conditions

The research objective of this study is: *What inter-organizational design would work best for care-cure conditions, so that patient's needs are met, and that problems due to fragmentation are overcome?* The literature review (Chapter 2) has shown us that there is no design that is superior over the others: each has its problems. The solution is found in moving towards integrated care, in improving collaboration between the different professionals and organizations involved. However, since it is not clear what inter-organizational design would be best, this research offers more insight by conducting an in-depth case study and by developing a simulation model with which different designs can be evaluated.

Overall this research teaches us that the inter-organizational design (a tiered system) has an effect on inter-organizational dynamics such as collaboration and trust, on the operations such as patient flows through the system, on patient's health and wellbeing, and on the interaction between those three. Thus a structural solution (having independent *care* and *cure* organizations, which take care of low-risk and high-risk patients) can result in unintended dynamics in the system: that of organizations not trusting each other, having patients being cared of in the wrong organization with the associated consequences.

More specifically, the following four implications can be made. Firstly, this research recommends that when evaluating the performance of a healthcare system, one should not only look into costs and medical performance, but also into the degree of fit between the organizational *design* and the actual *practice*. Since this can reveal underlying organizational design flaws, which could otherwise remain undiscovered. Secondly, this research shows that a design based on the focused factory concept, with separate organizations for different risk levels (low-risk versus high-risk) or for different needs (*care* needs versus *cure* needs) might not work for *care-cure* conditions. Thirdly, the literature on collaboration shows that there are several drivers and barriers to collaboration. However, in order to know which ones are the most important ones in a particular situation, one has to study the case setting in detail: for Dutch perinatal care these are trust and feelings of competition. However, for other conditions or other healthcare systems other drivers and barriers and dynamics might prevail. As such, this research recommends studying the dynamics of the collaboration between professionals/organization in relation to the condition specific characteristics in detail *before* deciding what new inter-organizational design might work best. Fourthly, the simulation model recommends implementing a collaborative model and it shows that improving care in only a part of the system (i.e. in certain organizations) will likely result in sub-optimal care in the system. However, the model is based on a particular *care-cure* condition (pregnancy) in a particular healthcare system (the Netherlands). Since there are some differences between pregnancy and other *care-cure* conditions (for example, a pregnancy only last for nine months, whereas other *care-cure* conditions are more life-long conditions), and since there are differences between healthcare systems, for other *care-cure* conditions, the model might need some adjustment, which might result in different outcomes.

Epilogue

Epilogue

In May 2013 I was finalizing my thesis. It has been over five years that I had been working together with the midwives and obstetricians in the region of Tilburg. The work we did in 2006 and 2007 marked the start of my research. When I left, in early 2008, the midwives and obstetricians were committed to improve perinatal care by improving the collaboration between the midwifery practices and the hospitals. So where are they at now?

Five years later, the organizational landscape has changed quite a bit. In the south, the hospital and three midwifery practices have integrated into one organization. Obstetricians and midwives work side by side, care is delivered in the hospital or in one of the locations in the community, and birth is given either at home or in the hospital. At the same time, the midwifery practices that remain independent of the hospital are still able to refer pregnant women to the hospital and to assist them in their delivery in the hospital.

In the north, a collaborative partnership has been formed, consisting of ten midwifery practices, the hospital in the north, and the main maternity care organization in the region. All organizations remained independent, keeping their own identity, but coordinating care better amongst the organizations: seamless referrals between the organizations, and working according to the same procedures and guidelines.

Two things are remarkable to me and maybe worth studying in more detail. The first regards the journey that the hospitals and the midwifery practices took; it must have been an interesting one. Eight years ago, twelve midwifery practices and two hospitals were working more or less in silos. In 2006, they started building trust amongst each other, collaborating more, and improving their care processes (see also Chapter 6). The focus has been on improving perinatal care *together*. But somewhere in the process, even though the overall goal never changed – a healthy pregnancy, a delivery without complications, and a woman (and her partner) that look back with great satisfaction to a great moment in her life (their lives) – some organizations shifted focus to doing so by integration into one organization, whereas others kept doing this by remaining organizational separate identities. As such, two designs emerged: the integrated and the collaborative one.

Secondly, I am curious to the outcomes of the two designs separately and to the outcomes of the system as a whole. Will the integrated and the collaborative design have different outcomes, and if so, what causes these differences? And will the outcome of the system as a whole be improved compared to the design where perinatal care was delivered by hospitals and independent midwifery practices.

The changes in perinatal care in Tilburg are still recent. The integrated care model has been put in place in 2012, the collaborative model in early 2013. I am looking forward to be in touch in the future to see how the two designs and the region develop further.

July 2013.

Acknowledgements

Acknowledgements

During my research, when I would read someone else's dissertation, I would always read the acknowledgements first; I was interested in the journey, the joys and the struggle of people who have been through the process before. In the early years of my research, I could hardly relate to what they had written, but when time passed and my research progressed further, I was more and more looking forward to the day that I would need to write my acknowledgements. And that day has finally come.

Pursuing a PhD can sometimes be hard and lonely work. I could not have done it without others, who supported and motivated me along the way, directly or indirectly. There are many people that I would like to thank, the following in particular.

First of all, I would like to thank Henk Akkermans. I have always valued your approach – starting in practice, applying group model building and system dynamics in order to understand what is happening – and I value your ability to find interesting, new angles to the research every time. Thank you for inviting me to join you on one of your sessions with the obstetricians and midwives. Your casual approach to working together was the right one for me: just start doing something fun, start with creating something beautiful, and let's see where it ends. You always have been an optimist, expressing your trust in me finalizing the PhD, even when I was just lingering around and being distracted by other things.

I would like to thank Kim van Oorschot, for being my roommate during my first year in Tilburg, for offering me an 'illegal' workplace every now and then at the Eindhoven University of Technology, and for becoming a member of my committee. Kim, without you I cannot imagine myself having finished this project. I really struggled to get my system dynamics model right, and the many calls that we had, you in Norway and I in California, you listening to my (modeling) considerations and giving me feedback, really helped me. Kim, thanks for being my supervisor, thanks for becoming my friend. I owe you many, many protein bars!

I would also like to thank Sally Brailsford. You officially joined the research in the last two years, but you had an impact way before that. We met for the first time in 2009, at the EURO conference in Bonn. I secretly hoped that you would attend my presentation (and you did!), and I remember being so proud when you commented on my research as being very interesting (and for correcting my pronunciation: woman-women). I was really excited that, two years later, you joined my committee. You commented in great detail on the research.

Many thanks to the obstetricians and midwives in Tilburg. They were a heart welcoming group of professionals. I thank them for opening up to me, for sharing their world with me, for putting me in a white coat so I could truly experience what they are up to every day. So far, I have never met a group of professionals with such a dedication to their profession, to the pregnant women and to each other. Even though they have their differences, even though improving the collaboration between them has not been easy, they never gave up. Day or night, they were always willing to improve their work. Their energy and motivation were inspiring and I truly enjoyed working with them!

Thanks to the people of Symmetric SD, who gave me to the opportunity to work with them, first as an intern, and later as a consultant. I learned a lot about system dynamics modeling and it was eye opening to learn about a healthcare system in another country. Brighton is a wonderful place, and when I hear seagulls I often think back at your office, where I would hear them through the open back door.

Special thanks also to Lambèr Royakkers, my former colleague, my business partner, and most of all, a really good friend. He has been my mentor for many years, showing me the fun of working in academia. He gave me the motivation to pursue a PhD. Thank you for supporting me along the way.

Many thanks to my family and friends. You supported me by having a drink, by going to live music together, by watching movies, by being interested in the research, by asking questions, and also by sometimes just *not* asking questions. I know you did not always understand the rather unusual path I choose for this, and I am happy that you still supported me along the way. Thanks to everyone who made me feel at home in California: the Stanford Masters Swimming Team, for being such a heart welcoming team and for offering workouts at noon, and the Rose and Crown and its regulars, for offering a beer and good conversations at all times.

Special thanks to those who provided me with a place to work while I was working remotely from California: the Stanford Green Library for the inspiring atmosphere and the welcoming staff, my friends from Stanford who provided me with internet access on the Stanford Campus, and Rick Bentley for sharing his office with me. It was great not having to work from home every day!

Working remotely, without colleagues, on your own, is not always easy. The following helped me get through the days and nights (in no particular order): Acda & De Munnik, Eminem, Pearl Jam, Amy McDonald, the yearly compilation disks of Remco Mulder, Neil Diamond, Jake Bugg, Nick Cave, Anouk, Madonna, Placebo, Kings of Leon, The National, Foals, Linkin Park, Metallica (with the San Francisco Symphony), Robbie Williams, The

Killers, Goldfrapp, K's Choice, Wolfendale, Starsailor, Zita Swoon, Stevie Ann, Marike Jager, Limp Bizkit, Novastar, Moke, John Mayer, Mintzkov Luna, Greenday, Hooverphonic, Moby, R.E.M., Shakira, Voicst, Yann Tiersen, and many more. Also not to forget Kink FM, Studio Brussel, and the Coen & Sander show. In addition: liters of tea, dark chocolate, Haribo (the bananas are unfortunately not available in the United States so I switched to cherries instead), Red Bull, m&m's (no, not the one with peanuts), my black sweater, and my blue sleeping bag.

Last but not least, I would like to thank Jan Jaap. Thank you for introducing me to Henk. Thank you for your support, which you showed in so many ways, for being patient with me, and for respecting my sometimes unusual work hours. You always motivate and support me in developing myself. I could not have done it without you.

Curriculum Vitae

&

List of Publications

Curriculum Vitae

Angèle Pieters was born on March 24th, 1978 in Weert. She grew up in Budel with her parents and her younger sister. In 1996 she received her VWO (high school) diploma from the Bisschoppelijk College in Weert. She studied Psychology at the Radboud University Nijmegen, where she finished her first year. From 1997 to 2002 she studied Industrial Engineering and Management Science at the Eindhoven University of Technology, where she received her Master's Degree. After her graduation, she joined the Teacher Training Program at the Eindhoven University of Technology and she graduated as a teacher in Mathematics in 2006. After this, she started her PhD at Tilburg University.

Angèle has been working on a variety of projects during her studies and her PhD. From 2000 to 2005 she has been working at the Department of Philosophy and Ethics at the Eindhoven University of Technology, during which she co-authored two books: Ethiek en Techniek (Ethics and Technology) and Verantwoord ondernemen (Business Ethics). In addition, in 2003 she co-founded two institutes: LIvET and IvET. LIvET offers teach-to-teacher courses in ethics, IvET offers courses to high school students, which prepares them for their final exams in mathematics, physics or chemistry. From 2003 to 2013 she was a managing director of both institutes. In 2008 and 2009 Angèle has been working as an independent business consultant for Symmetric SD in the United Kingdom, working in the mental health sector, often applying system dynamics modeling.

In 2010, Angèle moved with her husband to Palo Alto in California (United States). She is aiming to improve the healthcare system in the United States, as a management consultant and/or in academia.

List of Publications

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